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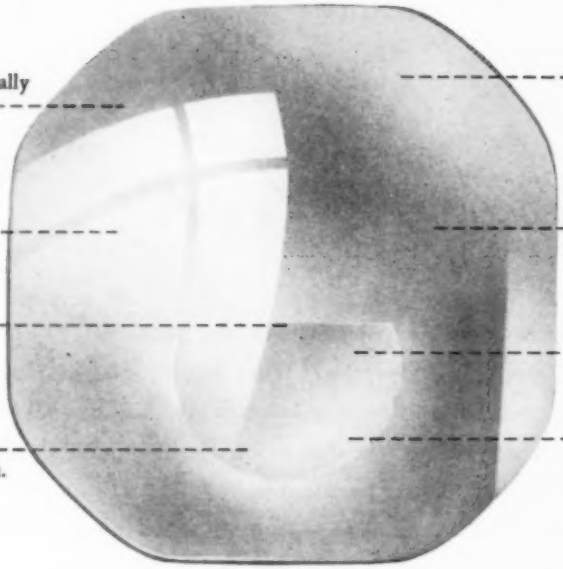
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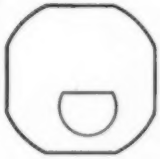

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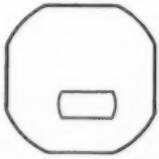

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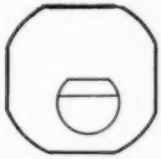

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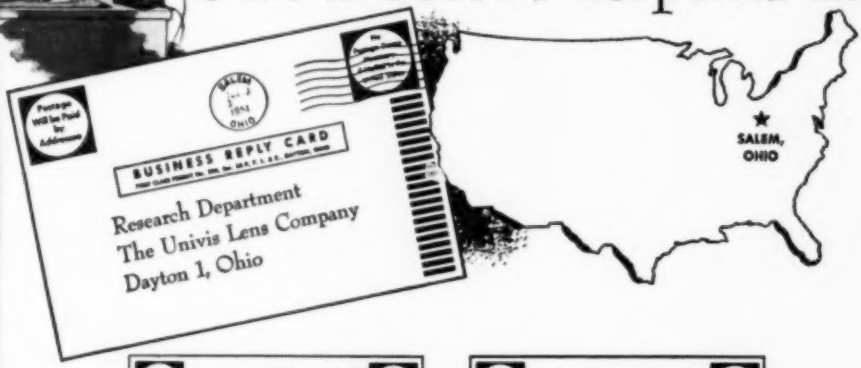

CASE HISTORY No. 265 — Executive, large Corp.—Adjusted better than to bifocals—Same Rx in CV lenses as was wearing in Round type Bifocal—CV lenses cleared up desk area which was blurred.

CASE HISTORY No. 262—Housewife, Adjusted better than to bifocals —First Pair of CVs in 1942—Always has duplicate pair.

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CASE HISTORY No. 249—Housewife, Adjusted better than to bifocals—Likes CVs for housework and card playing. Does not notice change from distance to close.

CASE HISTORY No. 264—Auditor, Adjusted better than to bifocals—Had trouble with Adding machine tape and large ledger sheets—CV eliminated blur area.

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CASE HISTORY No. 245—Store Mgr., Adjusted better than to bifocals—First Pair Satisfactory but wanted larger intermediate segment. Likes larger seg because so much of his work is done with the intermediate.

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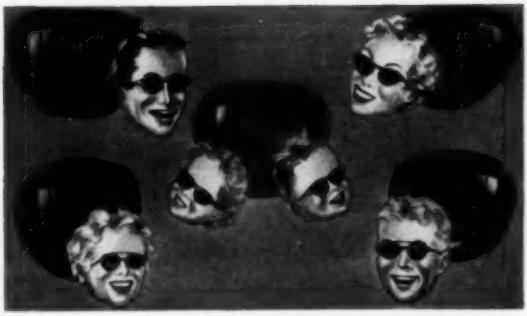

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Vol. 29 June, 1952 No. 6

SYMPTOMS AND CASE HISTORY—THE PATIENT AS A PERSON*

Robert E. Bannon†
Southbridge, Massachusetts

Introduction: With the increased number of specialized tests, techniques, instrumentation, systems of analysis and prescribing, classifications and quasi-psychological diagnoses that are becoming peculiar to the practice of optometry, there seems to be a tendency to disregard the "old-fashioned" concept of the patient-as-a-person; an individual who has definite symptoms and problems that he hopes to have relieved or for which he expects to be given professional advice. Frequently, patients are too often treated as cases of exophoria; as myopes or hyperopes; as a B_1 or B_2 type; as a convergent strabismic with anomalous correspondence; or, as a non-achiever with poor reading ability. This does not mean that such diagnoses are not helpful, but they alone are incomplete descriptions of the patient-as-a-person.

Have you not heard your colleagues mention an interesting case of amblyopia with eccentric fixation and neglect to refer to the reason why the patient sought an examination?

Have you not had patients who told you that they had been to Dr. So and So who gave them extensive treatments for something or other, but they were not satisfied because they still could not see the movies clearly?

This tendency to overlook the patient's symptoms in preference to a diagnostic classification is peculiar not only to optometry but may also be found in ophthalmology and other branches of medicine. I recall being present at a Motility Clinic in one of the large metropolitan eye hospitals while the case of a young colored woman was

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*Read before the annual meeting of the American Academy of Optometry, New York, New York, December 8, 1951. For publication in the June, 1952, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist. Staff member, Bureau of Visual Science, American Optical Company. Fellow, American Academy of Optometry.

being demonstrated. The patient had a large exotropia combined with some vertical deviation. The discussion was concerned with the various muscles that were involved and what might be the best operation to straighten the eyes. The patient had been first seen a month previously and had made several visits. The plotting of the deviations in the different directions of gaze and the diagnoses of what muscles were affected had been worked out very nicely. The doctor in charge of the case was proud of his findings and he had justifiable pride in plans for the necessary surgery. However, he was chagrined when the Chief asked why the patient had been admitted—that is, what were the patient's symptoms. The answer given was the the patient was, of course, concerned about the disfigurement of the squint. The Chief asked the patient how long her eyes had bothered her and the patient answered: "My eyes don't bother me at all. I've been wall-eyed since I was a child and all the doctors want to do something about it, but all I want to know is—is I pregnant or is I ain't?"

It may be presumptious to bring to this meeting, at which so many excellent technical papers are presented, a simple essay on symptoms and case histories. However, as chairman of the papers and program committee for our 1949 and 1950 meetings, I was reminded repeatedly by several Fellows of the paucity of papers on clinical subjects. This fact, together with my clinical experiences at the Dartmouth Eye Institute and at the Columbia University Optometry Laboratory, prompted me to prepare this paper. Since most of the patients seen at the above-mentioned clinics had consulted other eye specialists previously, there was an excellent opportunity to note from the referring doctors' letters the nature of the data presented which, in most instances, were very complete with the exception of all too brief accounts of the patients' histories and symptoms. I was again impressed with the importance of a careful case history and record of symptoms from the replies received from the 153 practitioners who answered my recent questionnaire on the factors involved in the prescribing of trifocal corrections. This survey[1] indicated clearly that the needs and symptoms of patients should be given primary consideration.

Chief Complaint: Although a patient may be referred by another practitioner whose letter describes the case, it is a good practice to ask such patients, as well as all other patients, to describe in their own words the *purpose* of their visit. This may be ascertained by the simple question: In what way do your eyes bother you?

Frequently, the patient has no significant ocular complaint, but feels it is time for a "check-up," or it may be that the patient has

broken or lost his glasses. Often, there is a complicated ocular condition found which is out of proportion with the patient's lack of complaints and, vice-versa, there are often patients with numerous symptoms but whose eyes are practically perfect.

The recording of the "Chief Complaint" is very helpful when, at the completion of the examination, the contemplated treatment is considered in the light of whether or not it is directed toward relieving the chief complaint. It has happened that a patient's chief complaint is that of difficulty in close work but the findings indicate that more minus power improves the distance vision and this is prescribed leaving the patient with the same, if not greater, discomfort for close work.

The *onset*, *frequency* and *duration* of the Chief Complaint are to be elicited as well as the important point of whether or not the Chief Complaint is associated with the use of the eyes. It is found frequently that patients are bothered by some discomfort—such as headaches—which are *not* associated with the use of the eyes but which the patient "hopes" will be relieved by new glasses. One must be on guard lest he give unwarranted hope or even a false sense of security to patients who have a serious vascular or neurological condition and who should have medical attention rather than new glasses.

Not only must the conscientious refractionist be able to evaluate the effects of dioptric changes but he also must be familiar with, and ready to admit, the limitations of dioptric treatment. While much has been written and more has been implied by some lecturers on the therapeutic value of picayune lens changes or various forms of orthoptics, we should ever be careful of being deluded into the belief that practically all maladies can be cured by ocular treatment.

Weir Mitchell[2] (1876) was perhaps the first in this country to insist upon the important influence of small refractive errors in the production of headaches and upon the general health and nervous disposition of patients long considered neurotic or suffering from some obscure pathological condition. He and Swan Burnett[3] (1887) were among the first in this country to realize and emphasize that asthenopia was a more frequent complaint of astigmats than poor vision. Since that time, refractive and binocular anomalies have been credited with a share in the etiology of almost every ocular disturbance as well as being contributing factors in a great many systemic, neurasthenic, and even social disturbances. Indeed, no less an authority than Duke-Elder[4] states that "eye-strain" has a tendency to reflect on the general health and mental well-being as well as being a fertile cause of the prolongation of neurasthenic states.

Duke-Elder[4] has proposed a convenient differentiation of symptoms into such groups as: *visual, ocular,* and *referred.*

(1) *Visual symptoms* include blurring, doubling, shadowing of print or other objects. These may be merely *observations* that annoy or worry the patient. These phenomena may not be accompanied by any ache, pain or other somatic discomfort but they may be of great concern to the patient. I recall one patient we had at Dartmouth—a middle-aged professor—who was greatly excited and feared his eyes were failing rapidly because he had noticed that after short periods of reading, a curtain string appeared doubled when he looked from his desk through the window. He had never noticed this phenomenon before but he had only recently moved his desk from against a wall to a place near a window. He had had several careful examinations and changes in his glasses but he continued to see the curtain string doubled whenever he looked past it at the landscape beyond. Dr. Lancaster, who was our Chief of Staff at that time, said he could cure him very inexpensively and he wrote a prescription which he handed to the patient. Upon reading the prescription, the pateint learned that he should go to the ten-cent store, buy a pair of scissors and cut off the offending curtain string! This dramatic therapy, combined with a sensible explanation of physiological diplopia "cured" the patient of his apprehensions and saved him many dollars.

(2) *Ocular symptoms* include those somatic discomforts described as eye ache, pain, fatigue, pulling sensation, burning, tearing, etc., and which collectively are referred to as "eye-strain" or "asthenopia." These symptoms, most commonly related to the direct use of the eyes, are the complaints most often amenable to the correction of a refractive error or neuro-muscular imbalance. It is important to determine whether the complaints are associated with specific uses of the eyes; for distance or near work, or both, and the therapy prescribed should be directed toward relieving the complaints without introducing new discomforts. This possibility is illustrated by the following case:

A photographer related that he used the same glasses for 20 years for retouching negatives and for reading. Recently he has experienced some slight discomfort for prolonged close work and he consulted an eye doctor who prescribed new glasses which, besides making the print clearer, also made horizontal lines run uphill and square objects appear rectangular. The patient explained that his doctor told him he should use the glasses all the time and the distortion would correct itself, but would reappear if he took the glasses off. The patient maintained that he needed glasses for close work only and, as he expressed it: "I cannot

see any reason to wear them all the time and create a situation that makes me see crooked without my glasses, when at present, I see everything true and straight. I am told I have astigmatism, and the glasses correct that. What I do not understand is—if I have astigmatism now, and can see everything true, why should I wear glasses to make me see everything untrue?"

Photophobia is often included under the heading of asthenopia as a local or ocular discomfort. Most frequently this term, "photophobia," is recorded on the record when the patient really means that excessive light or glare causes annoyance or a painless inability to see or to keep the eyes open. The term "dazzling" is more appropriate in the above instance since true photophobia is accompanied by blepharospasm and lacrimation. As Lebenson[5] points out in his recent paper, photophobia may be due to conjunctival, corneal, and iridic disease, head injury, migraine, or meningitis. We should refer patients suffering from true photophobia for an investigation of the basic pathologic condition rather than prescribe only palliative treatment in the form of tinted lenses. On the other hand, it is usually adequate to give tinted or absorption lenses to patients complaining of dazzling. This distinction between the often confused terms, "dazzling" and "photophobia," should be borne in mind as it will assist in the evaluation of the patient's symptoms and the proper disposition of the case.

(3) *Referred symptoms* include headaches of all types, gastrointestinal disturbances, vertigo, nausea, nervousness, general fatigue, etc., which the patient believes, or hopes, are due to his eyes and in many cases it is found that some ocular anomaly is a contributing factor. The most common referred symptom associated with inadequate refractive or neuro-muscular correction is headaches. Harold Simmerman[6] gave an excellent series of lectures on headaches at our Academy meeting last year. As mentioned previously in connection with ascertaining the nature of the chief complaint, it is important to determine the *onset*, *frequency* and *duration* and the extent to which the complaint is associated with the use of the eyes. This information is of great value in cases of headaches or of any referred symptom.

The location of the headaches is of some importance according to certain authorities. Ruedemann[7] in a recent paper mentions that frontal headaches may be caused by esophoria, hyperopia, anisometropia or hyperphoria; occipital and suboccipital headaches may be due to convergence insufficiency; some unilateral headaches may be caused by ciliary spasm, spasm of single ocular muscles, localized neuralgia, inflammation of the gasserian ganglion, etc.

One of the best chapters in MacBryde's book,[8] "The Analysis and Interpretation of Symptoms," is the one by Wolff on "Headache—Mechanisms and Differential Diagnosis." He discusses the mechanism of headaches associated with intercranial pressure, brain tumor, migraine, hypertension, anomalies of refraction and ocular motility. He points out the importance of obtaining a case history with respect to incidence, intensity, location, onset, duration, frequency, relation to muscle spasm, photophobia, periodicity, gastro-intestinal disturbance, vertigo, mood, sleep, fever, family history, etc.

While there is ample evidence that ocular anomalies are responsible for a great variety of headaches, we should not neglect to consider other possibilities. Sometimes, because a patient with headaches is found to have some measurable ocular aberration, treatment is confined for years to the eyes alone. A careful case history and analysis of the previous therapies may often reveal an unsuspected clue that will solve the problem. It is necessary to be somewhat of a detective in hunting down the cause of the patient's discomfort. I remember the case of a school teacher, referred by her physician for an aniseikonic examination, and whose chief complaint was that of one-sided headaches lasting for several hours for the past two years and occurring nearly every week. She had seen three eye specialists, worn five different refractive corrections, and had four months of orthoptics for convergence insufficiency. Although her eye doctor had not referred her to a physician, the patient had consulted one because her headaches were continuing and she had lost faith in the various eye treatments. Although some aniseikonia could be measured, I hesitated to prescribe a correction for it because of the complete lack of relief from her former glasses and because of certain details in the case history. The patient related that she did not have the headaches while at summer school where she used her eyes more than during the winter months. One point that stood out was that the headaches usually occurred on Fridays during the regular school year. Further questioning led to the fact that in the past two years she had roomed and boarded with a certain family but while at summer school, in a different city, she and some other girls had a small apartment where they did their own cooking. When asked if she was allergic to anything, the patient replied: "Oh, no, of course not. I think that allergy business is a lot of foolishness." However, when asked if her summer diet (when she had her own choice) differed from her boarding house meals, she did recall that she would never cook fish for herself and upon thinking about it, she mentioned that they always had fish on Fridays at the boarding house. She mentioned that

she had been brought up to eat what was served and although she was not fond of fish she ate it when it was served. However, she did admit that when she lived at home—prior to the beginning of her headaches—that her mother rarely served fish because, as she explained, "My father did not like the smell of fish being cooked." Our conversation, which began to suggest the coincidence of her headaches and the eating of fish, did not impress the patient. Even when I mentioned that it would be interesting if she were allergic to fish, the patient scoffed and said: "Oh, I couldn't be allergic to anything." However, when I reported to her physician the details recounted above, as well as my findings, he felt, as I did, that it would be worthwhile and certainly less expensive than aniseikonic glasses to have the patient abstain from fish for a month. If her headaches continued, we were going to prescribe the correction for aniseikonia. The patient, as well as her physician and I, were very pleased when at the end of a month the report was "no headaches." Following this particular case, the physician referred several other patients with obscure symptoms and he remarked: "I know you won't give glasses to everyone just because you find something wrong with their eyes, but you'll dig into their complaints and help me advise them."

In regard to the cooperation between optometrist and physician, a very good relationship can be attained that will be not only of mutual advantage but, most important, such a relationship can be most helpful to the patient. Another case which I have reported previously,[9] illustrates further the cooperation of optometrist and physician. A young man (age 16) with severe reading disability and personality difficulties was referred for examination and advice. Although this young man needed a significant refractive and aniseikonic correction, it was brought out in the case history that his main interest in life was to live and work on his grandfather's farm in Maine. After consultation with the physician, it was decided that the best thing for the boy would be to work on the grandfather's farm. A follow-up report at the end of a year indicated the young man was very happy on the farm and with the help of a rural school teacher he had made more progress in reading than he had done heretofore with expensive tutors and private schools.

History: Once the chief complaint is determined, appropriate questions should elicit pertinent information relative to the visual, medical, occupational and family history. Some patients will attempt to recount in considerable detail much past history which is not germane to the current complaint. Hence, it is best to first obtain the nature of the chief complaint and then direct the patient's recital of past events

which have some bearing upon the chief complaint. It is very helpful to determine what treatment the patient has had and to know the results of such treatment. A clue to the severity of the chief complaint is provided by the extent to which the patient has sought prior treatment. Sometimes the patient will enumerate many symptoms which would seem to be quite severe but upon inquiring into the history, we are surprised by the fact that the patient has not paid much attention to his complaints in that he has not sought professional advice for several years. When reminded of this point, the patient may remark: "Oh, I really could not be bothered running to doctors all the time. I am too busy." This suggests that the patient's numerous symptoms are really not much of a handicap and extensive investigations are not desired by the patient. On the other hand, those patients who have sought professional help frequently indicate thereby that they do wish to have extensive investigations.

As mentioned previously, the points in the history that should be elicited will depend greatly upon the nature of the chief complaint. In general, the following items of information should be sought: family history with respect to similar symptoms; ocular condition as a child; age and reason for first ocular treatment; what seemed to precipitate the chief complaint, i.e., illness, accident, new work, increased eye use, change of diet or other factors. It may seem unnecessary to inquire about when the patient wears his glasses because we are inclined to assume that if a person has glasses, they are used. However, I recall one 52-year-old woman who glibly professed about every symptom possible and who had half a dozen pairs of glasses, the prescriptions for which were practically the same as my findings (O.U. +3.00 sph with +1.50 add). When I asked her when she wore her glasses, she replied: "Oh, I never wear them." I had assumed her symptoms were present even when she wore the glasses but I learned to the contrary. She admitted that she had tried each pair of glasses for a day or two after first receiving them and, as she explained, "They worked very well except I could not see any better, if as well, when I took them off—and therefore I stopped wearing them as it was obvious they were not going to cure my eyes."

As evidenced by A. P. Coulden's[10] recent paper in the *British Journal of Physiological Optics*, our contemporaries in England are very much concerned about the history, symptoms and general observations of the patient before any "sight-testing" is undertaken. This point is worthy of mention in view of the fact that our British colleagues do not enjoy the professional status accorded to optometrists in this country. Hence, despite their lack of professional recognition, the British

refractionists deserve all the more credit for their interest in the patient-as-a-person rather than as merely a case of "sight-testing" for glasses.

Psychological Classifications: In recent years, there has been frequent reference to certain psychological disciplines (Gestalt, Holistic, Organismic, Personalistic, etc.) which emphasize the consideration of the organism as a whole rather than a sum of its characteristics. In certain instances, this has been overdone in that optometrists have ascribed to patients, attributes or deficiencies incompatible with scientific accuracy. Sheard[11] recently advised that it would be well for the non-medically trained practitioner to leave all of these things to the medical profession for otherwise such practices would resolve into unadulterated quackery. Nevertheless, we might take a cue from those modern psychologies which insist upon a complete synthesis of data, not only the anatomical and physiological measurements but, also, include a consideration of the patient's personal problems, his desires, needs and symptoms. It should be well-known that identical ocular anomalies in different individuals will cause distressing symptoms in one but not in another person. Likewise, identical symptoms in two individuals may have entirely different causes. This is not to say that there are no patterns or associations of symptoms and causes. However, there are no hard and fast rules and this is why we need professional judgment capable of evaluating the patient's history and symptoms in light of his anatomical-physiological data.

We might also be guided in some of our optometric procedures by observing the current trend in psychological testing toward what is known as the Projective Type Tests, typified by the Rorschach technique, and the Murray Thematic Apperception Test, which are "unstructured" tests. Psychologists are aware that many "structured" tests limit the capacity of the testee in revealing adequately his aptitudes, skills, interests or personality. Some of our optometric techniques, including the taking of the history and symptoms, are "structured" tests when we restrict or confine our patients to certain formalized procedures. Hence, while I agree that optometrists should not pose as psychologists, I believe we have much to learn from the psychological literature that would be helpful in our practices.

Referring Patients: The reputation of a successful practitioner is built upon not only those patients he has helped directly but as much so by those patients he has helped indirectly; that is, by referral to another specialist for diagnosis and treatment. We are all familiar with those grateful patients who have had headaches or other symptoms unrelieved by optometric treatment and whom we have helped obtain other professional care resulting in relief of symptoms or, what is some-

times of graver importance, the detection and treatment of an incipient condition, the neglect of which might have brought about an untimely blindness, impairment of health, or even death. I have had the experience, as I am sure many others have had, of receiving more recognition, not only in the form of subsequently referred patients, but also in the form of sincere appreciation, from patients I have referred to others.

There are some optometrists who feel very reluctant to refer a patient because they fear they will "lose a patient." It is a sordid fact to point out but, human nature being what it is, it seems necessary to emphasize that instead of a patient being lost, many more are gained by proper referrals. The consideration of the patient-as-a-person, rather than solely as a means of income, will bring more returns, not only financially, but more importantly, in personal satisfaction.

In referring a patient to another practitioner, it is not enough to say: "I have provided you with the best glasses possible and if your headaches continue you should have a physical examination." Sometimes patients have told me that their eye specialists have tried to convince them their headaches, or other complaints, were "imaginary." It is always best, in cases of *referred symptoms* especially, to consider your initial findings and correction as diagnostic and to insist upon a recheck. If, at the recheck consultation, the symptoms are reported as having been relieved, you may feel assured that your treatment was adequate. However, if the symptoms persist and your optometric findings are substantially the same as those obtained on the initial visit, you will have some important diagnostic information. You may have reason to suspect a vascular anomaly and instead of merely telling the patient to consult his physician, you should yourself arrange for a consultation with the physician and convey to him, either verbally or in writing, the patient's symptoms and history together with your findings.

Optometrists should feel encouraged to expect more cordial cooperation with members of the medical profession in view of recent developments which indicate a rising mutual respect. The recognition accorded optometry in the past few years is shown by the 1950 A.M.A. resolution permitting professional cooperation between ophthalmologists and optometrists; optometric representation on the National Interprofessional Committee on Eye Care and on The Healing Arts Educational Advisory Committee to U. S. Selective Service; as well as our increased rapport with the various states and the National Society for the Prevention of Blindness.

Another indication of the need for more thorough case histories and the important part they play in bringing about suspicion of path-

ological conditions is the growing inclination that optometrists should assume legal responsibility for the recognition of ocular pathology. Derrick Vail, President of the American Academy of Ophthalmology, at the time of his address[12] before the February, 1950 meeting of the Illinois Optometric Association, proposed that optometrists should seek legal responsibility for the recognition of ocular pathology. Vail pointed out that opportunities for more advanced training in ocular pathology for optometrists were now possible and it was the duty of our profession to avail ourselves of these opportunities.

Conclusion: The importance of a careful history with special attention to its relation to the Chief Complaint, its onset, frequency and duration, and associated phenomena, is of crucial value in the successful handling of patients. No instrumental measures or refractive data can take the place of careful consideration of the patient's complaints and history. One's ability to use special techniques and amass a welter of numerical data is a minor matter compared to the judgment of *when* to use certain techniques and to evaluate the significance of certain data as to its bearing upon the patient's complaint. This judgment is founded upon careful history taking and interpretation of the patient's symptoms. The practitioner's judgment in such matters will be proportionate to his ability to analyse and interpret his patient *as-a-person* rather than as a set of findings.

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TACHISTOSCOPIC TRAINING IN INDUSTRY*

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The rapid re-expansion of American industrial capacity as a result of the demands of the new defense emergency program have again brought into prominence many of the specialized programs and techniques designed during the last war to improve the basic visual, motor and mechanical skills of the employees of industry. Again industry has discovered that they cannot afford the wasteful luxury of inefficient production, faulty workmanship, and high accident rate previously characteristic of rapid expansion. World War II to a considerable degree taught industry the value of various testing and training programs designed to determine and improve the efficiency ratings of its employees. Testing programs have been developed and accepted by large segments of American industry in the broad fields of intelligence, personality, motivation, manipulatory and coordinative skills, achievement, aptitude and interest fields, overall physical needs, and visual skills. Many of the early programs hastily developed, were found after considerable trial to be useless and harmful in terms of wasted hours and reduction of morale. Consequently, adaptation and revision is continuously undertaken to meet the exacting needs and demands of industry.

In the field of vision, industry has learned to depend to a great extent upon visual analysis, visual skills measurement, and visual skills improvement programs as guides in the improvement of plant efficiency. The establishment of criteria for job standards, the development of test validation techniques, and the organization of testing programs and instrumentation have been given careful attention by optometry and groups allied to optometry. These criteria have been revised, modified, and improved within the last five years in an effort to increase their value and effectivity to industry.

An activity of even more recent origin than testing and screening, is that of the training of those particular visual skills found to be requisite to more efficient job performance. Depending upon the particular needs of an operation, training programs have been instituted for the improve-

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ment of ocular motility, improvement of fusion ranges, increase in depth perception abilities, and increase in the speed and span of perception.

A segment of industry by the nature of its specialized operation has been specifically interested in the improvement of speed and span of perception and the improvement of reading rates and comprehension. Those companies that employ large groups of people engaged in day long clerical and administrative work involving reading, filing and scanning have become interested in those procedures which will increase the output of workers. Banks, retail merchandizing firms, life insurance companies, government bureaus and telephone and telegraph companies feel that there is much to be gained from a program which will increase the speed and span of perception. However, such a program must not only produce the desired improvements but must be administratively adaptable within the company's framework of operation. This need has given rise to the organization of groups specifically designed to give such training. The Speed Reading Institute of New York is an example of such a group and such companies as Burlington Mills, Eastman Kodak, General Electric, Johnson and Johnson, Gulf Oil and others have adopted their program. Basically, the program designed centers about the use of such instrumentation as the metronoscope and its variations as well as the tachistoscope.

In 1950, this writer in discussion with executives of the Western Union Company learned of the desire on the part of the company to increase span of recognition and speed of perception. The company expressed a desire to train executives to read and dispose of their mail in less time: to train automatic operators to absorb elements of telegrams more accurately at the same speeds or with the same degree of accuracy at increased speeds: to train switching clerks to absorb routing information and to read addresses faster and more accurately. Costs to Western Union in time and money as a result of mistakes may be estimated to large proportions.

As a result of this discussion, an experimental study was designed and instituted for a group of Western Union employees to explore the possible effect and value of tachistoscopic training on the improvement of reading speeds as measured on a college speed of reading test and span of recognition as measured by the ophthalmograph. The plan was an exploratory investigation from which it was hoped sufficient information could be obtained concerning the actual statistical gains as well as a better understanding of the administrative and procedural problems involved.

SUBJECTS

The subjects employed for the study consisted of a group of 20 engineers who volunteered their lunch hours for the purpose of rendering an unsolicited service to their company and at the same time gaining an improvement in their general reading ability. The subjects were all male, college graduates of average age 46, ranging from 24 to 62 years, and as volunteers highly motivated. Of the 20 men, only 11 completed the entire program. The others dropped out at various stages of the training procedure.

PROCEDURE

In general the procedure consisted of seven definite steps, divided into test, train and re-test procedures.

To eliminate any factors of visual difficulties, each subject was given a refraction and correction and care were given wherever indicated. Visual skills were then taken on the Keystone telebinocular. This was followed by an ophthalmographic study and the administration of the Minnesota Speed Reading test for College Students, Part I. Subsequent to the preliminary testing, the specific training program with the tachistoscope was instituted.

Training commenced on November 19, 1950 with two 30 minute periods per week. After the first two weeks, the periods were increased to three per week for a total of 33 half-hour training sessions or a total of 16½ hours. This total included time taken for each student to record data and score test results. Actual flashing time consumed 12½ hours.

The subjects were seated four abreast in four rows with each row raised to a successively higher level. This permitted clear view for each subject while the screen stood 10 feet in front of the first row. The Keystone overhead projector and flashmeter were employed. The shutter speeds ranged from one to one-one hundredth of a second.

The first three periods were devoted to the flashing of four, five and six digits at various speeds between ½ to 1/100 second as a means of determining the general starting level of the subjects. At the conclusion of the third session the subjects showed the following results.

4 digits at 1/100 second	100% group average
5 digits at 1/100 second	84% group average

Inasmuch as the general level of the group varied between four and six digits a definite program was organized initially to satisfy as much as possible the needs of the different individuals. Four, five, and six digits were randomly flashed during each training session in order that each subject would be represented with material at his proper difficulty level.

Periodically, jump digit slides of three, four and five digits on eight spaces were presented along with the regular slides.

In the early training periods, subjects were given warning by the ringing of a bell two seconds before the flash. In the latter part of the experiment the bell signal was replaced by the verbal signal, "ready," 1½ seconds before the presentation. This proved to be more effective in keeping the subjects alert. Prior to all presentations a spot flash was employed to locate the position of the projected material on the screen.

During the course of the training sessions, only three or four slides were actually recorded. For the remainder of the slides different individual subjects were called upon for oral answers. This method had the advantage of increasing actual time spent on flashing and also retained the alertness of the group.

It might be mentioned at this point that there appeared to be a striking difference in the ability to reproduce digits when answered orally and when recording. For example, at the eighth session, several subjects could call six digits at 1/100 second with an accuracy of 90 per cent but could only attain an accuracy of 35 per cent if asked to record their answers. This difference was also pronounced when slides of geometric forms and phrases were presented. This may very well be a result of the emphasis of oral practice during the sessions with recording employed only periodically to determine the general status of the group at successive stages of training.

To obviate to a certain extent the dangers of boredom, laxity and disinterest which might possibly arise in a group of mature individuals, new slides of varying arrangements of digits were presented. They were:

3 digits on eight spaces.
5 digits on seven spaces.
5 digits on nine to thirteen spaces.
6 digits on eight spaces.
Double groups of four digits.
Double groups of five digits.
Moving groups of five digits.
Mixed groups of five digits and letters.
Geometric forms.
Nine digits at very slow speeds.
Triple groups of three digits.
Phrases and sentences of 17 to 27 characters.
Continuous running tape material.

At the 22nd session the special ticker tape projector was introduced for two specific purposes. Primarily to test the adaptability of such a device for the training of medium sized groups in terms of interest and secondarily because this type of presentation represented a specific similarity to the actual telegraph situation of reading rapidly moving tape.

The reading material was broken up into phrases of varying lengths depending upon the material and run across the screen with a special mask which limited the number of characters visible to the eye to about 20 at a time. The phrases were separated on the tape by blank spaces equal to twice the length of the phrases. The speed of operation of the instrument was set at a minimum of 500 characters of material per minute (1,500 characters per minute on the tape) and was gradually increased to a rate of 1,000 plus spaces per minute. Short sentences varying in length from 12 to 30 characters were projected at speeds from 2,000 to 3,000 characters per minute and subjects were asked to repeat orally the last phrase or sentence. This ticker projector is in a sense a modification of the tachistoscopic technique in that groups of phrases, sentences and characters were presented in rapid fashion to subjects. Purely for demonstration purposes, one of the Harvard controlled reading films was shown as a means of illustrating the type of training readily applicable to large groups.

During the 23rd training session a check test showed the class average score to be 73 per cent on 6 digits at 1/100 of a second. No additional checks of this nature were made as it was the intention of the experimenter to use the data of the reading tests and the ophthalmograph as a measure of the manifest effects of tachistoscopic training.

There was a total of 39 training sessions. At the completion of the training all the subjects expressed gratification for the opportunity afforded and felt there was considerable gain for the effort expended.

As a control group, 11 engineers were given the preliminary tests on the ophthalmograph and the Minnesota tests. At the conclusion of the training sessions the control group was again given the tests at the same time as the experimental group. During the period of training there was no contact with the control group.

DATA

Data were compiled on the pre-training and post training test results from Forms A and B of the Minnesota Speed of Reading tests for the 11 subjects who completed the training. The information was assembled in columnar form as to the number of paragraphs attempted: number of paragraphs correct: per cent of total paragraphs correctly marked: the Percentile Rank (as compared with the standard obtained from Minnesota college students): Scale values for each score, (scale values are in terms of tenths of standard deviations with an arbitrary zero point located at five standard deviations below the median represented by 50): and the reading speed words per minute.

Data were also compiled for reading speed from the above for

pre- and post training conditions. Data were also compiled from the findings obtained for the pre- and post training situation on the ophthalmograph. Also on the span of recognition, and for significance of gain.

The statistical analysis is based upon the hypothesis that there is no gain in any of the factors of reading skill herein discussed due to tachistoscopic training. The control group showed improvement in most categories which may have been due to familiarity and practice effects. In order to reject the hypothesis it was necessary to prove statistically that the gains made by the trained group, although greater than that of the control group, were significant to the extent that only by chance could such differences occur 1 per cent or 5 per cent of the time.

The method of analysis consisted of finding the individual differences between the pre- and post training scores. The mean of these differences was calculated and subtracted from each difference score to give a new score. The standard deviation of this new group of scores was then calculated. Both the experimental and control groups were given the same analysis. In testing for significance we found a t value from the ratio of the difference between the means of the differences between scores to the standard error of the difference between these means.

It appears from the statistics, that in spite of a gain of 21 per cent in reading speed on the Minnesota test, made by the trained group, the hypothesis cannot be rejected and the gain due to training is therefor insignificant even at the 10 per cent level. This may be attributed to the fact that although the groups were matched according to age and occupation, no attempt was made to match their reading levels before training.

The trained group showed an improvement of 12 per cent in span of recognition. This gain proved to be significant both at the 5 per cent and 1 per cent levels. The same significance also applied to the gains in reading rate as measured by the ophthalmograph.

In the factor of regressions as measured by the ophthalmograph, although there appeared to be an improvement of 38 per cent after training significance could only be obtained at the 5 per cent level.

No results were tabulated for the actual gain in the span of perception from direct testing as we were essentially interested in the transfer effects of this type of training on those factors which produce more efficient readers.

It appears from the data studied that although we have specifically trained for an increase in the span of perception, the gains recorded for

span of recognition and reading rate appear to be statistically significant at the 1 per cent level, whereas the gain in regressions appear to be significant only at the 5 per cent level.

My deepest gratitude to Drs. Alfred Lit, Milton Chodrof and Edward Lapidus for their unstinting aid in reviewing this report and its statistical analysis.

SUMMARY AND CONCLUSION

In an attempt to determine the effect of tachistoscopic training upon general reading efficiency of Western Union employees a group of 20 engineers were subjected to a group course of 39 tachistoscopic training sessions. Of the 20 subjects, 11 completed the course and the effectivity of the training was measured by testing on the Minnesota Speed of Reading test and the Ophthalmograph. The specific reading factors measured were speed of reading, span of recognition and the number of regressions per hundred words. A control group of 11 engineers of the same average age and range were also given the tests.

The results of the training as measured by the two tests, indicate that there appears to be a significant gain in span of recognition and reading speed; and a probable significant gain in regressions.

The subjective responses to the gains attained seem to be more significant than the statistical results. General efficiency, morale and comfort were reported by the subjects to be greatly improved.

In selection of groups, different results may well have been obtained from a less restricted younger group.

In the administration of training, full hour sessions with rest periods of company time might well improve gains and is worth investigating. Groups no larger than 15 seem to be ideal for group tachistoscopic training.

Further study is certainly necessary before Western Union is presented with a program based primarily on tachistoscopic training for the improvement of reading skills.

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INTERPRETATION OF ILLUMINATION DATA*

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Examination of the literature concerned with the relation of illumination intensity and efficiency of vision reveals certain practices in interpretation which need critical examination. To a large degree, the intensities recommended for effective vision are derived from such basic data as those obtained in studies on (1) relation of visual acuity to illumination level, (2) speed of vision as affected by brightness level, (3) visibility as affected by brightness level, (4) nervous muscular tension while working under different intensities of light, and (5) rate and accuracy of performance while working under different intensities of light. In most instances interpretations of relations between light and vision are based upon examination of the trends in the curves representing these basic data. Recommendations of illumination intensities for specific visual tasks are based upon these interpretations or upon values derived from these data by statistical manipulation. The purpose of this paper is to examine the validity of these practices.

Intensity of illumination is measured in footcandles and brightness level in footlamberts. One footcandle is the light intensity of a standard candle at a distance of one foot. One footlambert is the brightness of a perfectly diffusing surface which reflects 100 per cent of the incident light when illuminated by one footcandle. Since surfaces do not reflect all incident light, footlamberts are less than footcandles. For instance, a good quality of white print paper may reflect only 80 per cent of incident light. If the incident light on such paper is 20 footcandles, the brightness of the surface would be 16 footlamberts.

The light intensity of brightness levels listed as good practice or recommended for visual work in certain seeing situations frequently appear to be high. Luckiesh,[6] in discussing threshold, ideal, optimum and recommended footcandle levels, defines Task A as perfectly black critical details seen against a background which has a diffuse reflectance of 80 per cent. Reading black print on white paper tends to approxi-

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mate Task A. He considers that the limiting ideal footcandle level for such a task to be certainly above the level which produces a brightness level of at least 100 footlamberts, and that a conservative ideal brightness level is probably in the neighborhood of 300 footlamberts. Luckiesh further points out that recommended footcandle levels are almost universally compromises between threshold and ideal footcandle levels. And "any recommended footcandle level remains a compromise until it becomes an ideal footcandle level." This is typical of arguments that are employed to justify the relatively high illumination intensities found in such codes as those for Library Lighting,[10] School Lighting,[1] Home Lighting[9] and Industrial Lighting.[8] It seems reasonable to inquire into the validity of the interpretations of the data which are usually employed as bases for these recommended practices.

Studies dealing with the relation between visual acuity and illumination level are referred to repeatedly to justify the need of specific intensities or brightness values in visual work. A favorite study is that done by Lythgoe.[7] The test object was a Landolt broken ring. Average acuity scores are given for four subjects in his Table IV. Brightness values of the test object in footlamberts (equivalent footcandles) were 0.018, 0.051, 0.184, 0.427, 1.21, 5.20, 12.6, 38.8, 208 and 1275. The corresponding mean acuity scores obtained were 0.499, 0.717, 0.984, 1.17, 1.40, 1.71, 1.90, 2.10, 2.24, 2.35. Following the customary procedure, these mean scores are plotted on a logarithmic scale in Figure 1. Lythgoe points out that the relation between visual acuity and illumination level is a logarithmic function and should be plotted on a logarithmic scale. The tendency of the curve to reveal a straight line relationship supports the view that the relation is a logarithmic func-

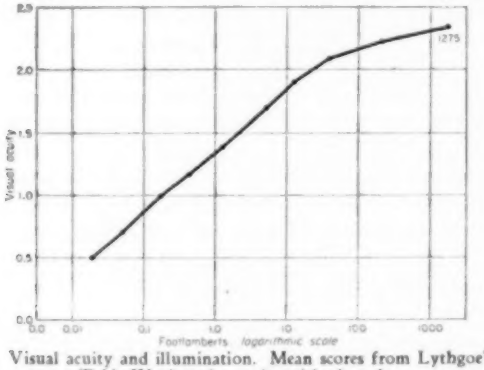

Fig. 1. Visual acuity and illumination. Mean scores from Lythgoe's (7) Table IV plotted on a logarithmic scale.

tion. Nevertheless such a curve can and frequently does lead to misinterpretations. Casual inspection would seem to indicate that there are marked increases in visual acuity as the illumination level is increased up to or even beyond 1275 footlamberts since the curve is still rising rapidly at the highest brightness used. Reference to the mean scores, however, reveal that the rate of increase in visual acuity from 38.8 to 208 to 1275 footlamberts is relatively slow. Thus, addition of 169.2 to 38.8 footlamberts yields an increase of only 0.14, and addition of 1067 to 208 footlamberts yields an increase of only 0.11 in visual acuity.

The changing rate of increase in visual acuity with increase in footlamberts is revealed to better advantage when the same data are plotted on a linear scale. This is done in Figure 2. Inspection of this

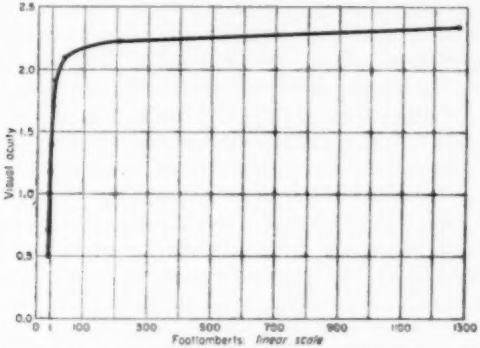

Fig. 2. Visual acuity and illumination. The same data as for Fig. 1 plotted on a linear scale.

curve suggests that the more important increases in visual acuity occur prior to a brightness level of about 50 footlamberts. Theoretically the increases in visual acuity at the higher brightness levels are of interest. But from the viewpoint of practical applications to seeing in specific situations, it is desirable to know whether the slight increases in acuity at the higher brightness levels are *significant*.

The data from Weston's[17] investigation of illumination and visual efficiency are frequently cited as a basis for recommended practice. The task was to identify the location of the break in a Landolt ring. Speed and accuracy were incorporated in the score. Different degrees of brightness contrast between test object and background were employed as well as different sizes of detail. As an example, the results for the 3 minutes visual angle of detail and a brightness contrast of 0.56 from Weston's Table III, p. 19, will be cited. Ten point type at the normal reading

distance (13 inches) produces a detail of approximately 3 minutes. Illumination intensities used were 0.5, 2.0, 8.0, 32.0, 128.0 and 512.0 footcandles. The corresponding performance scores were 0.30, 0.36, 0.425, 0.47, 0.485, and 0.49. When plotted on a logarithmic scale, the curve of improvement reveals a prominent rise up to 512 footcandles, the greatest intensity used. However, note that the actual score values of increased performance from 32 footcandles on are small. It takes an increase of 96 footcandles (32 to 128) to bring an increase of .015 in performance, and an increase of 384 footcandles (128 to 512) to yield an increase of .005 in performance. One may question whether these slight increases are *significant* in terms of practical application in everyday seeing tasks.

Another illustration may be cited. Feree and Rand[4] studied the relation between illumination intensity and speed of vision. The intensities ranged from 1.25 to 100 footcandles. The Landolt ring was employed as test object. Although the curves representing increased efficiency continued to rise up to the 100 footcandle level of light intensity, the actual decrease in time to perceive the test object was small at the higher values. For instance, the decrease in time of perceiving test objects 2 to 5.2 minutes in size as the illumination was increased from 20 to 100 footcandles was only 1.5 ms. (thousandths of a second). It would seem that changes of this magnitude are of no practical significance. Arnold and Tinker[2] have demonstrated that the shortest average pause of the eyes to discriminate an object (a printed letter) was 157 ms. In reading, the average pause ranges from 200 to 300 ms. When visual impressions succeed one another, as in every day life situations, Dodge[3] has shown that an exposure of 100 ms. is necessary for a fairly well cleared up visual impression. These data indicate that any decrease of a few ms. is of little or no practical importance, since the impression (stimulus) must act for at least 100 and more likely for 200 or more ms. for an adequate visual impression.

Data on the relation of visibility to illumination intensity and of nervous muscular tension to illumination intensity, when plotted on a logarithmic scale, reveal trends similar to those described above (see Tinker[14]). Consequently the practical significance of the changes in efficiency with higher intensities of light may again be questioned.

In the above discussion, attention has been directed at the questionable practice of interpretations based upon inspection of the trends in curves plotted on a logarithmic scale and then applying these interpretations to practical lighting problems. It seems relevant to inquire whether there are *statistically significant* gains in visual efficiency when

increases in illumination intensity are made. An appreciable rise in a curve plotted on a logarithmic scale does not necessarily indicate significant gains in visual efficiency. If a gain is not statistically significant, one is certainly not justified in arguing that the minute gains are of significance in the practical seeing situation. Investigators should always evaluate their data statistically to discover the significance of gains with increase in illumination intensity. This has been done in only a few studies.

Kuntz and Sleight[5] have investigated the effect of target brightness on "normal" and "subnormal" visual acuity. They computed the per cent of maximum visual acuity (acuity at 1000 footlamberts is taken as maximum) at each brightness level. The brightness levels in footlamberts were 3.16, 10, 31.6, 100, 316, and 1000. For the subnormal group the corresponding acuity scores in per cent of maximum were: 62.9, 70.5, 91.5, 95.4, 97.5, and 100; for the normal group: 83.6, 91.6, 92.9, 97.5, 97.1, and 100. When plotted on a logarithmic scale, the curves revealed the customary trends, i.e., they continued to rise appreciably up through the 1000 footlambert level. When the differences were evaluated statistically, there were no significant gains (1 per cent level of confidence) beyond 31.6 footlamberts for the subnormal subjects, and none beyond the 100 footlambert level for the normal subjects. The authors point out that the data show that adequate light for seeing details (visual acuity) is between 10 and 30 footlamberts for those with normal vision, and somewhere between 30 and 40 footlamberts for those with subnormal vision.

In another study, Simonson and Brozek[11] investigated the effects of illumination level on visual performance in a very severe task (perceiving series of very small printed letters). Illumination levels were 2, 5, 15, 50, 100, and 300 footcandles. The corresponding mean performance scores were 145.3, 167.4, 181.2, 188.3, 189.3, and 188.0. The curve (on a logarithmic scale) revealed a rapid rise to 50 footcandles, with a maximum at 100 footcandles and then a slight drop at 300 footcandles. Although the authors place some emphasis upon 100 footcandles as the optimum illumination, the difference in performance from 50 footcandles on are not statistically significant. They did find a significant drop in performance after two hours work in going from 100 to 300 footcandles. Although not computed, the scores would seem to indicate that the differences in performance drop through two hours of work are approximately the same for 15, 50 and 300 footcandles. Although the authors are inclined to conclude that the optimum illumination level for their visual task is between 50 and 300 footcandles, it

would seem sounder to conclude that it is in the neighborhood of 50 footcandles. In any case, further investigation is needed through the range of 30 to 100 footcandles before a more definite answer can be had.

In certain other studies of the relation between visual performance and illumination, obtained differences have been tested for statistical significance. In a preliminary study, Tinker[12] found no significant gain in performance in reading 10 point type for intensities above 3.1 footcandles. In a later study,[13] he found no significant gain in reading newspaper type for intensities above 7 footcandles. In a more severe task, Tinker[16] obtained significant increases in rate of reading 6 point italic print with increases of illumination intensity up to 25 footcandles. The determinations in these three studies by Tinker are the critical levels of illumination. As pointed out in the original reports, specified intensities for visual work should be higher than critical levels. In a later study, Tinker[15] evaluated the Weston-Crouch method of computing the illumination intensity necessary for effective visual discrimination in reading print. He found the method not valid and suggested that recommended intensities be based directly on experimental findings.

The above analysis emphasizes the need of statistical evaluation of gains in performance with increases in illumination intensities in situations where visual discrimination is required. To inspect the trends in plotted curves or to employ values derived through computation are not enough. Slight increases in efficiency which look important in the curves, especially when plotted on a logarithmic scale, frequently turn out to lack statistical significance when evaluated. When gains lack statistical significance, it seems reasonable to conclude that they cannot be significant in practical seeing situations irrespective of theoretical implications.

In most situations in everyday life, the visual discrimination required is supra-threshold. Such tasks are less severe than most visual acuity or visibility measurements. Nevertheless, visual acuity is one of the important factors involved. When statistical evaluations are made, the indications are that between 30 and 40 footlamberts or between 50 and 60 footcandles of light are adequate for even the more severe visual tasks. Even in the exceptional case, one cannot safely argue for more than 100 footcandles of light. These values are far below those specified from inspection of curves or those derived from computation.[15]

It is interesting to note the intensity values specified in the British lighting code, given in Weston's book.[18] They are relatively conservative. Apparently this is due to the fact that the British have taken into account much experimental data and also because they accepted as ade-

quate the 90 per cent level of Weston's maximum. It is relevant to note that when Kuntz and Sleight[5] reached 90 per cent of maximum acuity, further increases in illumination level brought no additional gains that are statistically significant. Apparently the British code has hit upon a criterion of high importance in specifying illumination intensities for practical situations. This is worthy of careful consideration in future discussions.

SUMMARY

1. The purpose of this paper is to examine the validity of current practices in interpretating illumination data.

2. It is common procedure to plot the relation between visual acuity and illumination intensity on a logarithmic scale. Then interpretations based upon the trends in these curves are applied to practical seeing situations. Small differences in visual acuity show up as marked gains in these curves in comparison with the apparent trends when plotted on a linear curve, especially at the higher illumination levels.

3. When there is statistical evaluation of the data, the small gains at the higher intensity levels are not significant.

4. It would seem reasonable to specify that significant gains in performance be established in illumination data prior to employing such data as bases for recommendations in practical seeing situations.

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ABSTRACT

THE ROLE OF THE EYE SPECIALIST IN CASES OF READING DIFFICULTIES. Robert E. Bannon. The Sight-Saving Review. 20.4.216-224. 1950.

This paper emphasizes the need for considering the educational and psychological, as well as the visual aspects in relation to all patients having reading disabilities.

Reading is such a complex achievement—a product of mind and eye—that consultation and cooperation between several specialists is frequently necessary. Too often is a child (or his parent) advised that there is nothing wrong with the eyes and many individuals have assumed that poor reading ability is due to an incurable lack of intelligence.

One conservative estimate is that 15 per cent of the school population of this country has some degree of difficulty in reading. Some estimates go as high as 40 per cent. Some of the many factors which influence reading and upon which learning to read depends are: The general intelligence, motivation, linguistic aptitude, vision, hearing, general health, and emotional stability. Usually more than one of these factors are present in an individual case.

The ocular factors of refractive errors, muscle imbalance, and aniseikonia are reviewed briefly and the use of monocular occlusion as a diagnostic test in recommended. However, it is pointed out that there are limitations to ocular therapy and the eye specialist should be alert in detecting those cases of reading disability which should be referred to specialists in other fields.

The author concludes that eye specialists should view their patients as persons rather than as a pair of eyes expressed by so many diopters of farsightedness or nearsightedness. In cases of reading disability, the eye specialist should do as much as he can to remedy what ocular troubles he can find; but he should not consider his duty completely discharged until he has made sure that other possible causative factors have been considered and treated.

AUTHOR'S ABSTRACT.

VISUAL FUNCTIONS AS INDICES OF PHYSIOLOGICAL CHANGES IN THE ACID-BASE BALANCE OF THE BLOOD*

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INTRODUCTION

The eye is embryologically and functionally in intimate relationship to the higher levels of the central nervous system and is richly supplied with blood vessels. For these reasons it is logical to expect that mild fluctuations of the physiological condition of the central nervous system and perhaps of the circulatory system might be associated with variations in certain visual functions which are subject to psychophysical measurement. It is also conceivable that if such variations in psychophysical measurements appear early enough they may serve as an index to variations in the physiological condition of the organism prior to the appearance of other objective or subjective symptoms.

For example it has been noted for some time that avitaminosis A is accompanied by significant changes in the course of visual dark adaptation (Hecht and Mandelbaum, 1939) and such effects are doubtless traceable to changes in the photochemical system within the retina. The literature on such effects has been reviewed elsewhere (Hecht and Mandelbaum, 1940).

Oxygen lack is known to have a deleterious effect on several visual functions. The effects of hypoxia on the course of visual dark adaptation (Bunge, 1936; McDonald and Adler, 1939; McFarland and Evans, 1939), on the latency of the visual after image (Gellhorn,

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1942), on the size of angioscotomata (Evans and McFarland, 1938), on the critical flicker frequency (Seitz, 1940), on foveal visual acuity (McFarland and Halperin, 1939; Berger, McFarland, Halperin and Niven, 1943) and on brightness discrimination (Gellhorn, 1936; McFarland, Halperin and Niven, 1944; Hecht, Hendley, Frank and Haig, 1946) have all been demonstrated.

The effect of insulin hypoglycemia on brightness discrimination is similar to the effect of hypoxia (McFarland, Halperin and Niven, 1946).

Enzer, Simonson and Blankstein (1942) found that the critical flicker frequency was lower in 22 patients with hypertension and cardiac disease than the lowest value measured in 47 "normal" subjects. Such studies suggest the possibility of using psychophysical measurements of visual functions as indices of diseased conditions. Extending these observations Krasno and Ivy (1950) found the c.f.f. to be lower in 216 patients with hypertension or coronary arterial disease than in "normal" subjects. In 99 per cent of these patients oral administration of 0.4 mg. of nitroglycerine produced a rise in the c.f.f. while in the "normal" subjects the administration of the same dosage of the vasodilator produced a fall in the flicker fusion frequency. This test appears to have value in the diagnosis of hypertension and coronary arterial disease in subclinical stages.

The critical flicker frequency has also been used as an index of "fatigue" of the central nervous system (Simonson and Enzer, 1941; and Brozek and Keys, 1944), and as an "objective" index of intelligence (Halstead, 1947; and Tanner, 1950).

The literature outlined above indicates that measurements of visual functions such as the absolute rod threshold and the critical flicker frequency may frequently be employed as valuable indices of changes in physiological condition of the organism. Recently, there has been some evidence accumulated which suggests that changes in the acid-base balance may also be associated with changes in visual functions. Rubinstein and Therman (1935) found that hyperventilation was associated with an elevation in the critical flicker frequency while Gellhorn (1936) and Otis, Rahn, Epstein and Fenn (1946) found that both low and high CO_2 tensions of the blood had a deleterious effect on brightness discrimination. On the other hand Wald, Harper, Goodman, and Krieger (1942) found that low CO_2 tension of the blood was associated with a rise, and high CO_2 tension with a fall in the sensitivity of the rods.

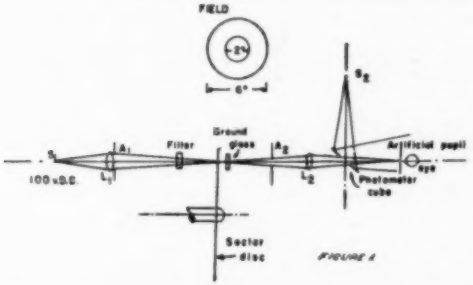
The present investigation is an attempt to ascertain if these respiratory effects are due to changes in the hydrogen ion concentration of the

blood, or to a direct effect of carbon dioxide. In order to compare these effects on rod and cone function, measurements were made not only of the rod threshold but also of the critical flicker frequency at levels of luminance and in a retinal region which insured cone vision.

PROCEDURE

The absolute threshold for the rods was determined for a region 3° above the fovea for a 1/5 of a second flash of light using the constant stimulus method. Frequency of seeing curves were determined for 8 normal young adults (after 30 minute dark adaptation) by means of the Hecht-Shlaer (1938) Adaptometer. The absolute threshold was determined by taking the intensity of retinal illuminance at which the stimulus was seen 60 per cent of the time.

The critical flicker frequency was determined at a variety of levels of retinal illuminance by the device illustrated in Figure I. Details of



the apparatus will be described elsewhere (Hendley and Alpern, 1950 a). For the present purpose it will suffice to point out that a circular 2.3° flickering test field was surrounded by an annular background, the external diameter of which was 6°. The measurements were made using the psychophysical method of average error. The subject looked monocularly through a two millimeter artificial pupil and varied the frequency of exposure of the light stimulus (light-dark ratio 1:1) bracketing the fusion point of flicker until he was certain that he had determined the maximum frequency at which the flicker was perceptible. The procedure was repeated until consistent readings were obtained and the arithmetic mean of these readings was taken as the c.f.f. under the specific conditions. Care was taken to keep the luminance of the surround equal to the Talbot luminance of the flickering stimulus and this was possible as long as this latter was less than 35 mL. At higher luminance levels the surround was kept at 35 mL., and this fact tended

to make the c.f.f. readings at these higher levels somewhat lower than might have been expected if the surround and Talbot luminance of the test field were equal (Fry and Bartley, 1936).

Metabolic acidosis was produced by the oral administration of ammonium chloride (4-8 mM./kg. taken over a period of 24-36 hours). Metabolic alkalosis was produced by the oral administration of sodium bicarbonate (8-12 mM./kg. taken over a period of 1-6 hours). Respiratory acidosis was produced by having the subject breathe a mixture of 7% CO_2 and 93% O_2, while respiratory alkalosis was produced by causing the subject to hyperventilate voluntarily. At frequent intervals after the onset of alkalosis or acidosis, measurements were made of the absolute threshold and of the critical flicker frequency.

Blood samples were taken at appropriate times using the method of Dautrebande (1926) and the blood pH, HCO_3^-, and pCO_2 determined by the techniques described by Davenport (1950).

RESULTS

1. *The Absolute Visual Thresholds.* The summary of the results of some of the experiments on the effects of variation of the acid-base balance of the blood on the rod threshold are given in Table I. These results will be reported in more detail elsewhere (Hendley and Alpern, 1950 b), but the essential facts are illustrated by the data in this table. The first column gives the physiological condition, the second column gives the number of experiments, while the third column gives the average change in the pH of the blood. The fourth column gives the average change in the threshold in logarithmic units together with its standard error. The last column lists the probability that such a change in the threshold could have occurred by chance.

TABLE I
Effect of Variation in Acid-Base Balance on Absolute Threshold.

Condition	*N*	*Mn* ΔpH	*Mn* Δ*Threshold*	*P*
Respiratory Alkalosis	28	+0.18	−0.16 ± 0.03	<0.001
Respiratory Acidosis	22	−0.12	+0.231 ± 0.04	<0.001
Metabolic Alkalosis	8	+0.10	+0.10 ± 0.11	<0.3
Metabolic Acidosis	19	−0.10	+0.01 ± 0.03	<0.7

From the table it is apparent that metabolic alkalosis and acidosis are not associated with significant variations in the absolute threshold of the rods. On the other hand, variations in the acid-base balance of the blood produced by variation of the pCO_2 of the blood are asso-

ciated with quite significant changes in the absolute threshold. Respiratory alkalosis produced by voluntary hyperventilation is associated with a fall in the threshold of 0.16 log units while respiratory acidosis produced by breathing 7% CO_2 in the presence of ample O_2 is associated with a rise in the threshold of 0.23 log units. Further experimentation (Hendley and Alpern, 1950 b) shows that similar results may be obtained when changes in the blood pCO_2 are superimposed upon conditions of metabolic acidosis or alkalosis.

2. *The Critical Flicker Frequency.* The summary of the results of some of the experiments on the variation in the blood acid-base balance on the critical flicker frequency (in 12 normal young adults) is tabulated in Tables II and III. These results will be reported in more detail elsewhere (Hendley and Alpern, 1950 a), but the tables illustrate the essential facts. In these tables the first column lists the physiological condition, the second column gives the number of experiments, while the third column gives the Talbot luminance of the flickering stimulus in millilamberts. The fourth column gives the average change in the blood pH while the average change in critical flicker frequency together with its standard error is listed in the fifth column. The last column again gives the probability that such changes might have occurred by chance.

TABLE II
Effect of Variation in Acid-Base Balance on c.f.f. (Metabolic)

Condition	*N*	*B(mL)*	*Mn* ΔpH	*Mn* $\Delta c.f.f.$	*P*
Acidosis	16	400	—0.11	—0.3 ± 0.3	<0.4
Acidosis	16	4	—0.11	—0.1 ± 0.4	<0.9
Alkalosis	9	400	+0.11	+1.6 ± 1.00	<0.2
Alkalosis	9	4	+0.11	—0.1 ± 1.3	<0.5

Table II gives the results of the experiments with metabolic acid-base changes. It is apparent that although slight changes in c.f.f. occur by variation in the fixed acid or base of the blood these changes are not at all significant.

Table III gives the results of the experiments with respiratory acid-base changes. Respiratory acidosis was associated with a fall in the critical flicker frequency of approximately four cycles per second at two luminance levels (400 and 4mL.) of the flickering stimulus. Respiratory alkalosis, on the other hand, was associated with a rise in the critical flicker frequency of from approximately 3 to 5 cycles per

second. These effects are quite significant. Further experimentation (Hendley and Alpern, 1950 a) shows that similar results may be obtained when changes in blood pCO_2 are superimposed upon conditions of metabolic acidosis or alkalosis.

The results of 111 experiments on changes in c.f.f. associated with changes in respiratory acid-base changes are illustrated in Figure 2. In this figure the ordinates show the c.f.f. in cycles per second and the abscissae, the logarithm of the Talbot luminance of the test field in millilamberts. These data include only the results of the experiments in which the changes in c.f.f. with acid-base changes were significant to the 0.001 level. In this figure the filled circles represent the normal c.f.f. values, the open circle c.f.f. data obtained during hyperventilation and the circles with crosses c.f.f. values obtained while breathing the mixture of 7% CO_2 and 93% O_2.

TABLE III
Effect of Variation in
Blood Acid-Base Balance on c.f.f.
(Respiratory)

Condition	*N*	*B(mL.)*	*Mn* ΔpH	*Mn* $\Delta c.f.f.$	*P*
Acidosis	22	400	—0.16	—3.8 ± 0.3	<.001
Acidosis	23	4	—0.16	—4.4 ± 0.4	<.001
Alkalosis	11	4,500	+0.20	+4.8 ± 1.1	<.001
Alkalosis	23	400	+0.20	+2.8 ± 0.7	<.001
Alkalosis	32	4	+0.20	+3.2 ± 0.6	<.001
Alkalosis	7	0.25	+0.20	+5.3 ± 1.7	<.02

Figure 2 demonstrates that the variation of c.f.f. as a function of luminance follows the Ferry-Porter Law for the respiratory alkalosis and acidosis as well as for normal subjects for moderate levels of luminance. The slope of the straight line portion of the curves is 10 which is in reasonably good accord with earlier measurements (Hecht and

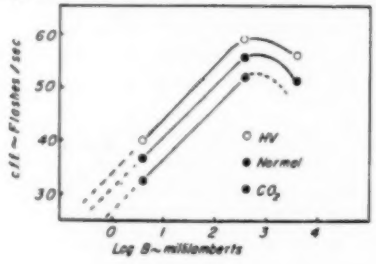


FIGURE 2.

Verrijp, 1933). The subsequent fall in the c.f.f. at the highest luminance level can probably be attributed to the fact that the surround luminance could not be made equal to the Talbot luminance of the flickering field at this level.

Figure 2 demonstrates the fact that the effect of hyperventilation is manifest at all luminance levels, including the very highest one measured, and that the effect is a change in maximum discriminatory ability, rather than a shift to a higher or a lower light level. This effect will be discussed in more detail in a subsequent section.

DISCUSSION

The results of these experiments demonstrate two important facts: (a) Changes in acid-base balance of the blood which are produced metabolically are not associated with significant variation of the critical flicker frequency or of the absolute visual threshold. (b) On the other hand, changes in the acid-base balance of the blood which are produced by changes in the concentration of CO_2 in the blood are accompanied by significant changes in the critical flicker frequency and the absolute visual threshold. It may be concluded from these data that the alterations of the visual functions demonstrated in these experiments are not indices of changes of the blood pH *per se* but are rather indices of the variation of the blood pCO_2.

It is, perhaps, necessary to point out that analagous results have been obtained with peripheral nerve (Lorente de No, 1947). One is tempted to conclude, consequently, that the effects obtained on visual functions are due to changes in excitability of nervous tissue somewhere central to the photoreceptors. Such a hypothesis is especially attractive since changes in visual functions (brightness discrimination, visual acuity, and absolute thresholds) due to hypoxia and insulin hypoglycemia have been suggested as occurring in this way (Hecht, Hendley, Frank and Haig, 1946; McFarland, Halperin and Niven, 1946).

However, as attractive as this hypothesis appears, its adoption ought not to be made before an exhaustive effort has been exerted to see if the results are not explicable at the photoreceptor level. This is especially true since all such hypotheses are based on indirect evidence. Consequently, the theory which is suggested below is advanced merely for the purpose of demonstrating that, insofar as the facts are known at the present time, the effect of CO_2 on the visual mechanism might perhaps occur at the level of the photoreceptors.

Before attempting to analyze the effect of changes in blood pCO_2 on the absolute threshold and on flicker it might be desirable to review the theory of the response of a photoreceptor to a flash of light. The

action of light in eliciting a nerve impulse from the photoreceptor is thought to be mediated by a photochemical process. The characteristics of this process have been studied in some detail by Hecht and his co-workers and by others. Jahn (1946) has proposed a modification of the Hecht theory which may be illustrated in the following way:

$$S \rightarrow E \rightarrow P + A \rightarrow S.$$

The action of light is to decompose the photosensitive substance *S* into *E* and this in turn then breaks down into two photoproducts *P* and *A* which recombine to form *S*. Denoting the concentrations of *S*, *E* and the two photoproducts as *s*, *w* and *x* respectively, the rates of these reactions will be

$$\frac{dw}{dt} = k_1 I s, \tag{1}$$

$$\frac{dx}{dt} = k_2 w, \text{ and} \tag{2}$$

$$\frac{ds}{dt} = k_3 x^2 \tag{3}$$

where *I* is the intensity of retinal illuminance and the *k's* are velocity constants. It is assumed that the sum of the three concentrations *s*, *w* and *x* is equal to a constant *a*.

That is

$$a = s + w + x. \tag{4}$$

E catalyzes a secondary reaction,

$$L \xrightarrow{E} T.$$

Denoting the concentrations of L and T as *l* and *u* respectively, the rate of this reaction is

$$\frac{du}{dt} = k_4 l w. \tag{5}$$

Fry and Alpern (1946) have extended this theory with the assumption that T diffuses from the point at which it is produced to another point at which it is consumed in the production of nerve impulses. The concentration of T at this point may be designated as *v*. A nerve impulse is produced whenever a certain critical amount of T ($\overline{\equiv}\Delta v$) accumulates at the region of impulse production and this value of *v* determines the absolute threshold as well as the frequency of impulses produced by supraliminal stimuli. According to this analysis it can be shown that

$$\bar{\bar{\Delta}}v = \frac{k_4 I w'''}{k_5}\left(1 - e^{-k_5 \bar{\bar{\Delta}}t}\right) \qquad (6)$$

in which $\bar{\bar{\Delta}}t$ represents the time required for v to reach this threshold value $\bar{\bar{\Delta}}v$, w''' is the equilibrium value of E and k_5 is the velocity constant for the reaction expressing the slow dissipation of v, which is

$$-\left(\frac{dv}{dt}\right) = k_5 v . \qquad (7)$$

In any stage of the response the frequency of nerve impulses (F) is equal to the reciprocal of $\bar{\bar{\Delta}}t$ and may be determined from the following equation which may be derived from equation (6)

$$F = \frac{1}{\bar{\bar{\Delta}}t} = \frac{1}{\ln \dfrac{\bar{\bar{\Delta}}v k_5}{k_4 I w'''} - 1} \qquad (8)$$

If the frequency of the response is of the order of five per second or higher, equation (8) may be approximated by:

$$F = \frac{k_4 I w'''}{\bar{\bar{\Delta}}v} . \qquad (9)$$

Hence:

$$\Delta F = \frac{k_4 I \Delta w}{\bar{\bar{\Delta}}v} . \qquad (10)$$

In the case of intermittent light exposed at the frequency f, the concentration of E fluctuates above and below an "equilibrium" value, w''', once the eye has become adapted to the Talbot luminance of the flickering stimulus. In this situation the amount of E formed during the light phase will be equal to that dissipated during the dark phase, consequently:

$$[k_1 I s''' - k_2 w'''] \frac{1}{p} \Delta t = k_2 w''' \left(1 - \frac{1}{p}\right) \Delta t \qquad (11)$$

or

$$w''' = \frac{k_1 I s'''}{p k_2} \qquad (11a)$$

in which Δt represents the duration of the cycle and $\frac{1}{p}$ the fraction of the cycle during which the light is on.

The amplitude of this fluctuation around the equilibrium level is given by

$$\Delta w = [k_1 Is''' - k_2 w'''] \frac{1}{p} \Delta t = k_2 w''' \left(1 - \frac{1}{p}\right) \frac{1}{f} . \quad (12)$$

Substituting equation (10) in equation (12) and solving for ΔF gives:

$$\Delta F = \frac{k_4 l}{\Delta v} (k_2 w''') \left(1 - \frac{1}{p}\right) \frac{1}{f} = \frac{k_4 l k_1 Is''' \left(1 - \frac{1}{p}\right) \frac{1}{f}}{\Delta vp} . \quad (13)$$

In this equation ΔF represents the total variation in frequency of impulses as a result of the intermittent stimulus.

The basic or equilibrium frequency (F''') upon which this modulation is imposed, is given by:

$$F''' = \frac{k_1 k_4 I l s'''}{pk_2 \Delta v} . \quad (14)$$

The equilibrium value of s is given by the following equation:

$$s''' = \frac{k_3 (a - s''')^2}{k_1 I} . \quad (15)$$

This analysis of the response of the photoreceptor to intermittent light has been made by Fry (unpublished paper). The variables in the equations derived by it may be classified into two separate categories: (1) those associated with variation in the stimulus conditions, i.e., l, p, and f, and (2) those which may be related to the physiological condition of the photoreceptor, i.e., l, a, Δv, $k\rho$, k_2, and k_4.

At the rate of alternation necessary to just eliminate flicker, a dampening of the effect of intermittency must occur either at the photoreceptor level or at a synapse at some higher level in the visual mechanism. The mechanism of this dampening is still not understood. However, it is possible to predict by means of equations (13), (14) and (15) the manner in which a given change in one of the physiological variables will affect the critical flicker frequency. This is done by holding all other variables constant and manipulating the desired variable in order to ascertain the resultant effect on F''' and ΔF.

An increase in ΔF will increase the visibility of flicker because

it increases the amplitude of the modulation. An increase in F''' will also increase the visibility of flicker because it increases the basic frequency which makes possible the transmission of the modulation with greater fidelity. An increase in the visibility of flicker requires a higher rate of alternation to abolish the flicker. If compensatory mechanisms do not occur at different levels, whatever raises the value of l, s''', k_1 or k_4, or whatever lowers the value of $\equiv{\Delta v}$ or k_2 will raise the critical flicker frequency.

In the case of a flash of light of duration greater than the retinal action time, the threshold intensity I_t can be determined from the following equation which may be derived from equation (6):

$$I_t = \frac{k_2 k_5 \equiv{\Delta v}}{k_4 l k_1 s'''} \quad . \tag{16}$$

Equations (15) and (16) show that the threshold I_t may be varied by a variation in $\equiv{\Delta v}$, k_4, k_2, k_5, k_1, a, or l.

In attempting to formulate a hypothesis as to the manner in which changes in the blood pCO_2 affect the visual mechanism, in light of the theory of the photoreceptor response outlined above, it might be assumed that the variation in blood pCO_2 affects one or more of the physiological variables.

The assumption that $\equiv{\Delta v}$ varies implies that a change in blood pCO_2 affects the excitability of the photoreceptor to a given photochemical change. Hyperventilation, for example, could cause a fall in $\equiv{\Delta v}$ by producing a fall in the blood pCO_2. This would produce a fall in the absolute threshold as is illustrated by equation (16). It would also produce a rise in the critical flicker frequency since it would raise the values of ΔF and F''' in equations (13) and (14). In an analagous way, raising the pCO_2 could be predicted to raise the absolute threshold and to lower the critical flicker frequency by raising the value of $\equiv{\Delta v}$.

It is possible, however, that the change in the pCO_2 of the blood affects the l or a in the photoreceptor. Such variations could be most readily mediated by variation in diameter of the blood vessels which supply the photoreceptors. For example, if hyperventilation caused an increase in the diameter of the vascular supply to the photoreceptors by lowering the blood pCO_2, the available l (or perhaps a) in the photoreceptors would be increased. This would cause a fall in the absolute threshold and a rise in the critical flicker frequency. Breathing CO_2

by raising the blood pCO_2 and constricting the vascular supply to the photoreceptors would have the opposite effects.

It should be pointed out that the changes in critical flicker frequency which would be predicted by making either of the above assumptions should occur equally at all luminance levels of the flickering stimuli. This is in accord with the facts such as they are known at the present time. However, the relationship of these data to the effects of hypoxia on brightness discrimination, the absolute threshold, visual acuity and critical flicker frequency cannot be determined at the present. Insofar as brightness discrimination and visual acuity are concerned it has been established that the effects of hypoxia and of insulin hypoglycemia are analagous to the effect of looking through a neutral density filter, i.e., hypoxia causes a displacement of the acuity or brightness discrimination curve along the intensity axis, so that at the moderate luminance levels the effect will be more marked than at the high luminance levels. In the case of the effect of hypoxia on the critical flicker frequency, the data are not as unequivocal in this respect. Seitz (1940) found that hypoxia produced a reduction of the critical flicker frequency at all intensity levels measured but pointed out that the range of luminance values employed was not sufficient to determine whether or not these effects are explicable as a shift along the intensity axis.

According to the above analysis it is conceivable that the rates of the reactions might be affected by the pCO_2. However, the physiological mechanism whereby a decrease in the blood pCO_2 would produce an increase in the rate of the reaction described by Equation (5) or a decrease in the rate of the reaction described by Equation (2)—either of which *could* account for the available data—is far from clear. The results of these experiments cannot be explained by an increase of k_1, since this would act to shift the c.f.f. vs. log I curve along the intensity axis, or of k_2, since this would not affect critical flicker frequency.

For the present it is not possible to decide between the hypotheses advanced above. However, it may be pointed out that the effects of blood pCO_2 changes on blood flow are marked. For example, cerebral blood flow increases when the pCO_2 of arterial blood goes up and decreases when the pCO_2 is low (see review by Schmidt, 1944). On the other hand, Huerkamp and Rittinghaus (1950) have some evidence to show that hyperpnea (low pCO_2) produces a dilation of the retinal arteries and veins. This lends some support to the hypothesis that the changes in pCO_2 of the blood cause variation in the amount of l (or perhaps a) in the photoreceptor. However, it must be noted further that

the nutritional supply of the photoreceptors is thought to be from choroidal and not retinal blood vessels.

SUMMARY

Respiratory acidosis is associated with a rise in the absolute visual threshold and a fall in the critical flicker frequency, while respiratory alkalosis is associated with a fall in the absolute visual threshold and a rise in the critical flicker frequency. Changes in CO_2 tension affect both rod and cone vision. Comparable effects do not occur with metabolic alkalosis and acidosis. Theoretical analysis demonstrates that such effects are explicable at the level of the photoreceptor.

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ANNOUNCEMENT

Proposals concerning a fundamentally new fee structure for optometrists will be discussed in the lead article of the July issue of this Journal, and the report is recommended for careful reading by all optometrists. The article, written by Dr. Carel C. Koch, Editor, in collaboration with other optometrists, is entitled, "Suggestions for a New Fee Structure in Optometry." Look for it next month. The report promises to be the most discussed subject in optometry in the coming months.

A CASE OF DISLOCATED CONGENITAL SUBLUXATED LENSES*

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MARFAN SYNDROME

A congenital condition characterized by widespread aberrations in mesodermal tissues of the body. The main characteristics are elongation of the long bones, especially of the hands and feet, spinal curvatures, a dolichocephalic skull, undeveloped musculature, flat feet, hammer toes, absence of subcutaneous fat and in 40 per cent of the cases subluxated lenses with tremulous iris. The syndrome is also known as arachnodactyly. (See: Burch. 1936 *Archives Ophthal.* Vol. 15, pp. 645.)

CASE HISTORY

Miss F. K., age 49, was first seen by this writer on December 21, 1948. Her case report dating back to March 17, 1941, was available for reference. Patient had been recorded as a Marfan Syndrome in 1941. She was not informed. All factors in above definition were present in this patient, curvature of upper spine, long hands, fingers, legs, and feet, and a lens anomaly. Medical history complicated, under care for low blood pressure and mild anemia. Has liver shots regularly. Teeth in good repair. Other members of family have faulty vision.

COMPLAINT

"I do close work, much typing, and have pain in eyes and headaches every day about noon. No difficulty on week-ends."

Visual acuity: Unaided. R. 5/200. L. 20/400. Aided. R. 20/30 .75M. L. 20/40 .50 M.

EXTERNAL OCULAR EXAMINATION

Lids normal, conjunctiva mildly injected, cornea clear, anterior chambers unevenly shallow.

OPHTHALMOSCOPY

General cortical lens opacities O. U., lenses displaced superiorly and laterally each eye. Inferior border of lens capsule just visible at lower edge of pupils. Fundus very difficult to observe.

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Old Rx —2.25 —2.25 x 130 = 20/30
—4.25 —2.75 x 70 = 20/40
+1.75 add for reading.

OPHTHALMOMETER

R —2.75 x 100
L —3.00 x 90

RETINOSCOPY

Undependable

SUBJECTIVE

R —3.00 —2.50 x 125 = 20/30
L —4.00 —3.50 x 65 = 20/40 +.
+ 2.25 add = .37M
1 degree right hyperphoria.

The refraction was most difficult. The above subjective determined after refraction on three different days. The patient reports constant clearing and blurring of vision which is explained by shifting of crystalline lens. The anterior surface is in direct contact with posterior surface of iris. Dilation and contraction of pupil could cause slight lens movement, sufficient to disturb vision.

Note: A standard contact lens was tried on left eye with resultant acuity of 20/20. This acuity could not be obtained by ophthalmic lenses. The good acuity with contact lens ruled out possibility of macular involvement.

The subjective finding with + 2.25 add was prescribed without vertical prism. A + 1.00 sphere clip-on was also prescribed for piano playing.

FOLLOW UP

January 28, 1950, patient reported with following complaint: "Had severe headache one week ago, then each day there seemed to be something in front of right eye which I cannot rub off. Now I see purple through right eye." Visual acuity with glasses, R. 20/60. L. 20/100.

OPHTHALMOSCOPY

Crystalline lens of each eye has shifted inferiority, right greater than left. Referred to ophthalmologist, findings substantiated. Cause not determined. Patient denies any injury or fall. To be observed. No treatment.

January 31, 1950, Miss F. K. reported for observation. Stated that, "Vision very blurred in right eye on awakening each morning.

Vision seems to clear after being up and around for awhile." Can see purple and orange most of the time. No pain. Patient was encouraged to discuss any factors that may have contributed to displacement of lenses. She then said she was most embarrassed to tell it but that she had been doing exercises to try to straighten her spine. The evening before the severe headache she had been lying on the floor doing the "bicycle exercise;" she rolled over bumping her head severely. The next morning the symptoms appeared. It was decided to make no change of patient's correction. She was to return periodically for observation and for refraction when she felt eyes were more steady.

July 28, 1950, "I think my vision is better: would like to try to get better glasses."

OPHTHALMOSCOPY

Right lens displaced more inferiorly. Nearly two-thirds of superior pupil clear. Fundus easily seen, appeared normal. Left lens in approximately normal position.

SUBJECTIVE

R +12.25 sphere = 20/20 +
L —2.75 —5.00 x 75 = 20/40 + 2.
+2.50 add .37M

Left lens only changed to above subjective.

CONCLUSION

Patient was extremely happy with possibilities of right eye. A temporary aphakic correction was tried for three days. Miss F. K. found vision bright and clear but unfamiliar. She preferred to continue with left eye for the present. The purple vision reported was due to chromatic dispersion of crystalline lens. Further complications are possible in this case, but at present patient reports vision satisfactory and steady.

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CONTACT LENSES AS AN OCCUPATIONAL REQUIREMENT — A CASE REPORT*

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CASE HISTORY

Ocular History: Miss G. G., age 19, presented herself for corneal lens consultation on May 9, 1950. She has been wearing spectacle lenses for eight years and her present correction for eight months. She secured her first lenses in order to see more clearly in the classroom and at movies. They have been changed twice in the past eight years, little change being made each time. A myopic condition of sufficient degree exists so that much form and all detail are visually lost at appreciable distances.

Health History: The patient is in excellent health. The only diseases she remembers having are the measles and mumps.

Family History: The patient is an only child. Her mother is myopic and father hypermetropic.

School History: The patient graduated from high school where she was an average student and pursued a general course.

Occupation: The patient is a skater with the Ice Capades. All her work is confined to group skating with timing depending upon music and visual cues.

Social and Recreational History: When time is available the patient likes to participate in swimming, tennis and dancing.

Complaints: "I want corneal lenses because I need them for my work. They won't let me wear glasses when I skate and I can't see without them. Our ballet instructor told me I had to get contact lenses because I sometimes missed my cues. I also think that my glasses need changing as the right one seems too weak and the left one too strong."

PRELIMINARY FINDINGS

External Examination: The lids, sclera, conjunctiva, puncta, cornea and iris are without evidence of pathology. Versions and rotations reveal no apparent restrictions in movements. Motion and form fields are adequate. Direct and consensual pupillary reactions to light

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are normal as is that to accommodation.

ANALYTICAL EXAMINATION

Present Rx. R. —1.50 D. sph. L. —3.00 D. sph.

Visual acuity: Unaided. R. 20/400—. L. Finger count at 7'. O.U. 20/400. With Rx. R. 20/40—2. L. 20/15—1. O.U. 20/15—1+.

Ophthalmometer: R. 43.50/180. 44.25/90. L. 44.00/180. 44.75/90.

Static retinoscopy: R. —1.75 + 0.25 x 15. L. —3.00 + 0.25 x 10.

Dynamic retinoscopy: R. —0.50. L. —1.75.

Subjective test: R. —2.00 20/20+. L. —3.00 20/15—1.

Exophoria 2Δ. Adduction 7/5. Abduction 17/11.

Hyperphoria 0.

Accommodative convergence insufficiency: 5½ Δ.

Positive Fusional Reserve: 26/12.

Negative Fusional Reserve: 34/22.

Positive Relative Accommodation: —2.50.

Negative Relative Accommodation. +3.00.

Fused Cross Cylinder: R. —0.25. L. —1.25.

Accommodative Amplitude: R. 8.00. L. 7.75.

Diagnosis and Treatment: As the patient plans to use the corneal lenses for her work which is not restricted to near areas there was no reluctance in giving her a full correction. This was done. For distance an exophoria and relatively low adduction are evidenced, contra-indicating a reduced correction as the exophoria would then be increased and the adduction reduced. At near, no findings other than the fused cross cylinder test indicate an acceptance of plus power. On the other hand, the addition of plus would increase the accommodative convergence insufficiency and reduce the positive fusional reserve. It would also reverse the relative accommodation if prescribed in amounts exceeding +0.25 D. The accommodative amplitudes seem sufficient to meet near requirements. Recent reports from the patient indicate visual and occupational satisfaction from the use of corneal lenses.

SUMMARY

The patient skates with the Ice Capades. She is myopic and, as she is not permitted to skate while wearing her lenses, she often misses visual clues. She desires corneal lenses so that she may see properly while skating.

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A MESSAGE TO THE OPTOMETRY CLASSES OF 1952*

You are going into your professional careers at a time of great change in our country itself. A time of crisis, and a time when some of our old cherished values are undergoing change. The thought of practicing again in a peace time world—for instance. Yet, the fundamental principles of professional life remain the same, honesty in your dealings with patients whose interest must come before everything else.

You men are going into practice at a time when the clash of international viewpoints bring tensions which reach right down to the very levels of your practice-to-be on main street, U. S. A.

Tensions which take your patients from their homes to serve

*An excerpt from the 1952 Commencement Address presented at the graduation exercises of the Pennsylvania State College of Optometry, Philadelphia, Pennsylvania, June 2, 1952, by Carel C. Koch, O.D., D.O.S., Editor, American Journal of Optometry and Secretary, American Academy of Optometry.

with the military. Tensions which move families from one State to another in war industry. Tensions which add billions to our tax loads, and tensions which inflate our monetary values adding much to your cost of practicing—and your cost of living.

Tensions, too, which pit group against group and which bring to the forefront thoughts and ideas quite unique when compared to those held by those splendid individualists who founded this country many years ago.

And how will these matters of vital import affect you? What impact will they have on your practice to be? The answer is both *much* and *little*. In part it depends on you and the part you, as an individual, play as an optometrist and citizen. In part, too, it also depends on how closely we as an optometric group can work out the problems of the next decade.

There will be many of these. The whole question of professional fees must be restudied and for the good of the profession, the whole fee structure in optometry must be radically changed, I sincerely believe.

The whole question of proper refractive eye care for the indigent and those in the low income groups must be properly solved. The whole question of institutional and industrial eye care cannot be ignored much longer. The proper type of career service for optometrists in the military is yet not too clearly defined. Our relationships, while improving, between ophthalmology and optometry are a field for much useful work, and the position of opticianry and optometry is an area to which much thought must be given. These and many other problems will confront you as new practitioners and the solution to each will have its impact—either good or bad—on your practice.

As you read these lines, you are probably thinking—"Just what can I do as a new practitioner to help solve these problems?" The answer is much. First, you can practice in such manner as to bring credit upon yourself and your profession. Optometry is judged, far more than we realize, by the individual acts of optometrists in practice. It is only occasionally that we, as an associated group, have the opportunity of making a collective impact upon the public. But, as individuals, in our practices and in our lives, we make, from day to day, lasting impressions on all those with whom we come in contact. Not only in our offices, but in the every day conduct of our affairs.

Unconsciously—the public judges optometry as a profession by the manner in which the neighborhood optometrist practices. In that practice you, as an individual optometrist, can make or break optometry with a certain large segment of the public. Your practices, and the way

you live your lives, therefore, become the first important contribution you can make towards solving the optometric problems which lie ahead.

To be sure—as an individual working alone—even then you could do little towards the actual solution of the problems mentioned. As a rule, such solutions come through collective effort on the part of many optometrists working through our associations, both State and National—but here, too, my first point is most important. If all of the optometrists in an area practice professionally, the collective power of the group is greatly enhanced in their dealings with public officials and opinion molders who form and create policy which can work for or against the profession's best interest. So I urge you first—right from the start—to build your practices around the professional ideals which have served all professions so well in the past.

In addition, I urge you to work in harmony and close association with your fellow optometrists. Throw the weight of your thinking, action and influence with your fellow practitioners in your local, state and national association, as it is in these groups, by joint collective action that in time these troublesome questions can, and will be, solved. Solved not only to your satisfaction, but also to the satisfaction of the profession and the public. And what is even more important, solved in the patient's best interest.

In other words, as you get into practice, support your association, and in so doing your association is made more effective in bringing about the solutions we all desire.

During the more than 50 years of organized optometry in this country our profession has been fortunate in avoiding the dangers of divided leadership. From the very start we have been adequately served by one large national association of optometrists. Most optometrists belonged, and by their active participation were able to make the splendid progress which has characterized our profession. To be sure, there were times when the association failed to please many of its members, but by working on the problems from within rather than by staying out and criticizing, the solutions to these former problems were found and put into effect.

Only recently—in fact since last year, a very small dissatisfied minority has been threatening to form a rival organization to fight the code of practice as adopted by the American Optometric Association two years ago. In place of staying in the A. O. A. and working out their problems in a democratic manner, this splinter group has elected to divide the ranks of the profession and thus weaken our position as it affects us on all major issues.

This is a serious and basic mistake, and one which, if successful, will prove very costly to all optometrists in the years ahead.

As a professional group, we can only succeed by presenting a united front to any and all adversaries, and as a democratic group, the minority must submit to the will of the majority, reserving for itself, as a minority, the right of proper and orderly protest and appeal.

Our basic and fundamental optometric organization, the A. O. A., permits these processes through specific actions and resolutions on the part of its component state associations. The A. O. A. is well developed. It is strong, and has served the profession well in the past and will do so again in the future.

I urge you men who are coming into the profession at this time to use your every influence to keep optometry united and strong. Your state optometric association is your first line of defense. Your A. O. A. is your reserve strength. Support both on all occasions.

The advantages you now take for granted in coming into optometry were all worked out and fought for by these organizations in the years gone by and the accumulated strength of these organizations is at your disposal today.

CAREL C. KOCH

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

LOCAL CHAPTER ACTIVITIES

MICHIGAN CHAPTER

New officers elected for the Michigan Chapter of the American Academy of Optometry are: Chairman, Dr. Paul Connolly, Detroit; vice chairman, Dr. Robert E. Van Sluyters, Grand Rapids, secretary-treasurer, Dr. Wayne H. Chapman, Charlotte.

Dr. Robert E. Bannon, Bureau of Visual Science, American Optical Company, and Dr. S. Howard Bartley, professor of psychology, Michigan State College, were recent speakers at educational sessions held by this Chapter.

NEW YORK CHAPTER

Dr. Lawrence Lewiston, Fellow of the New York Academy of Optometry, recently spoke on "A Comparative Study of the Various Forms of Contact Lenses," at the spring New York Chapter meeting.

This Chapter is honoring Dr. Elias J. Margaretten, New York City, with the New York Academy Plaque for distinguished service to optometry.

MARYLAND CHAPTER

At the spring meeting of the Maryland chapter it was decided to undertake a research project to determine the frequency of color blindness existing monocularly and binocularly. Dr. Israel Dvorine was appointed chairman of the project, with all members of the chapter participating.

NORTH CAROLINA CHAPTER

Fellows of the North Carolina Chapter heard four lectures and elected officers at their annual spring meeting. Program chairman John D. Perry, Jr., arranged the lecture program at which Dr. Michael Curcio of the faculty of the Pennsylvania State College of Optometry talked on, "The Snellen Chart:" "Percentage Evaluation of Visual Acuity:" "Lens Effectivity in Relationship to True Ametropia:" "Tonometry and Provocative Tests and Surgery in Glaucoma."

Officers elected were as follows: President, Dr. Henry B. Day, Jr., Raleigh: Vice president, Dr. Dorothy Calhoun, Forest City: secretary-treasurer, Dr. John D. Perry, Jr., Winston-Salem. Elected to the executive council were Dr. P. W. Green, Mount Airy: Dr. E. O. Roland, Brevard: Dr. Lee M. Wheless, High Point, and Dr. John T. Campbell (ex officio), Washington.

CURRENT COMMENTS

Virginia Huck
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department: such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

STATUTORY REGISTRATION OF OPTOMETRISTS IN GREAT BRITAIN

After years of work, Great Britain's Interdepartmental Committee on the Statutory Registration of Opticians (optometrists) has completed its recommendations to the Minister of Health for setting up a registration program. The recommendations have been published and the government of Great Britain is now considering the report. In brief, the interdepartmental committee made the following report:*

Legislation should provide for the establishment of a General

*Taken from the Interdepartmental Committee Report, Summary of Recommendations, published as a supplement to the *Dioptric News*, May 9, 1952.

Optical Council, consisting of an independent chairman and 20 members nominated or elected by the Privy Council, by the optical examining bodies, by ophthalmic opticians, by dispensing opticians and by the medical profession. There should also be a registrar, appointed initially by the Privy Council and thereafter by the General Optical Council.

The Council should establish and maintain registers of ophthalmic and dispensing opticians possessing the prescribed qualifications.

There should be three registers: one for opticians who test sight and dispense glasses; one for dispensing opticians; and one for opticians engaged solely in sight testing. The registers should show the names and approved qualifications of the opticians registered.

All opticians should be eligible for registration who have already been approved by the Central Professional Committee for Opticians to take part in the supplementary ophthalmic services of the National Health Service. Applicants not on a Central Professional Committee's list should be required to possess the appropriate certificate, diploma or higher diploma of one of the recognized optical examining bodies.

The Council should be empowered to register approved qualifications taken by applicants abroad. In doing this work they should assess foreign qualifications and recognize them where satisfactory. They should, wherever practicable, insure that the recognition of British and of Commonwealth or foreign opticians is mutual.

In regard to inspection of examinations and training, the Interdepartmental committee had this to say:

The great need in optical students' education is for the establishment of a coordinating body with powers of visitation, inspection, criticism and enforcement.

The Council should organize methods of inspection, both of the optical examining bodies with regard to their examinations and of those institutions which provide, or intimate that they wish to provide, optical training. The first aim should be the establishment of a common minimum standard, both for the preliminary education of opticians and also for their specialized training and examinations.

The Council might well base their methods upon those of the General Medical Council, though they may at first need to intervene rather more directly than is the practice of that body, in order to establish a satisfactory minimum standard.

The Council should publish lists of approved optical examining bodies and training institutions, to which they should add after the inspection of applicant bodies.

On disciplinary powers, the committee recommended:

The use by an unregistered person of the titles "ophthalmic optician," "dispensing optician," or of any other words calculated to suggest that that person is a qualified optician, should be statutorily prohibited, and no unregistered person should be allowed to practice ophthalmic or dispensing optics. The Council should have power to prosecute where these powers are contravened.

The Council should exercise general disciplinary powers over registered opticians and should have power to admit, remove and restore names to the register. They should inculcate and enforce throughout the profession an appropriate ethical standard.

The committee touched on intraprofessional cooperation in recommending that ophthalmic opticians and ophthalmic optical students should receive more instruction by medical men in certain subjects. They should receive practical instruction in the recognition of ocular abnormality from doctors possessing ophthalmic qualifications. Doubt about the respective scope and aims of the two professions should be cleared up, both among the professions themselves and among the public.

Other recommendations included the following:

Registered ophthalmic opticians should be recognized as competent to test sight and supply any necessary glasses but not to diagnose ocular or other disease.

The Council should record, in the register, any approved specialist qualifications in orthoptics by registered opticians. There should be the closest possible liaison between ophthalmologists, ophthalmic opticians and orthoptists in the treatment of children suffering from squint.

The Council should consider whether there should be control over the prescribing and fitting of contact lenses, and should be empowered to make regulations should they decide that such control is desirable. They should consider what specialist qualifications in this subject they are prepared to approve. If a registered optician holds an approved diploma, this should be recorded.

The Council should consider the question of the use of drugs by ophthalmic opticians and should, in consultation with the Health Department, prepare a list showing the drugs which opticians make use of and the strengths in which they should use them.

Just what action the Government of Great Britain will take on this report remains to be seen. The fact that the interdepartmental committee could come to agreement on the proposed recommendations

surprised some of Britain's practitioners who considered the job almost hopeless. Many in Great Britain feel that statutory registration will straighten out some of the difficulties in the administration of the National Health ophthalmic service and strengthen intraprofessional relations. Only time will tell, and this department will report from time to time on the situation as it progresses.

OPHTHALMOSCOPICAL SKETCH PAD AVAILABLE

An ophthalmoscopical sketch pad designed for recording the findings of an ophthalmological examination has been placed on the market by the American Optical Company. The charts on the pad allow an accurate recording of observations of importance. The fundus on the charts is colored in light orange and mottled with medium orange. Light detail can be marked on the fundus by erasing the color or scratching the surface with a pin; darker or heavier detail can be drawn in with a pen or sharp pencil. The fundus on the chart is five and one-half inches in diameter.

Both the light orange macula and the white elliptical optic disc have been accurately placed, and for ease in locating detail, the periphery of the fundus has been divided into eight equal parts. Any sheet can be used for either left or right eye by turning the sheet 180 degrees. Dr. Conrad Berens, New York City ophthalmologist, supervised the designing of the sketch pad for American Optical Company.

NEWS BRIEFS

A 25-year history of the Women's Auxiliary of the American Optometric Association will soon be off the press. Work on the history has been going on for several years. The Auxiliary movement got under way in Washington, D. C., in 1927 and celebrated its 25th anniversary at the New Orleans 1951 Congress of the A. O. A. Mrs. W. C. Ezell, Historian, is now taking orders for the book at her headquarters, 616 Rutledge Street, Spartanburg, South Carolina (Price $3.00). . . . John J. Rohrbach of Rochester, New York, was recently elected president of Shuron Optical Company, and Beverly Chew, Geneva, chairman of the board. . . . A three-day visual research conference planned to bring about an exchange of experiences, techniques, and results of research conducted on light, vision and seeing in leading laboratories took place at General Electric Lighting Institute, Nela Park, recently. It was the second conference of its kind, the first having been held in 1950. Symposiums covered color factors in seeing, efficient vision, and visual fatigue. Twenty-three research scientists and specialists from

universities and laboratories were invited. Among those taking part were Sylvester K. Guth, Dr. S. Howard Bartley, Dr. Richard Feinberg, Dr. Glenn A. Fry, Dr. R. M. Hall, Dr. D. B. Harmon, Dr. Henry W. Hofstetter, Dr. K. B. Stoddard, Dr. Joseph Tiffin and Dr. Miles A. Tinker. . . . Another conference concerned particularly with lighting was held May 21-23 in Pittsburgh. Illumination as a dynamic force in the renaissance, growth and progress of a community was the theme of the East Central Regional Conference of the Illuminating Engineering Society. The light and vision story was covered by Dr. Henry S. Kane, Jr., of the Pittsburgh Optometric Society. . . . Dr. James F. Wahl, Anna, Illinois, vice president of the American Optometric Association, made the convocation address at Northern Illinois College of Optometry at spring commencement. Sixty junior and senior students received their degree of Bachelor of Science in Optometry. . . . Los Angeles College of Optometry conferred the degree of Bachelor of Visual Science on one student, the post-graduate Doctor of Optometry degree on six, and the Doctor of Optometry degree on 79 students (one posthumously) at its May graduation exercises. . . . The Blakiston Company, medical and scientific publishers in Philadelphia for over 100 years, is moving to 575 Madison Avenue, New York 22, in the late summer of this year, joining its parent organization, Doubleday and Company, Inc. . . . A placement service office has been organized at Columbia University School of Optometry. Dr. Edward L. Steinberg, faculty member, will be in charge. This aid to professional optometric placement will start in June. Interested optometrists should write Columbia Optometry Placement Service, 132 West 60th Street, New York 23. . . . Among the speakers at the Central Atlantic Optometry Assembly May 29—June 1 were Dr. John C. Neill, director, Contact Lens Clinic, Pennsylvania State College of Optometry; Dr. Arthur R. Neale, Jr., past president of the New Jersey State Board of Optometrists; Dr. Thaddeus Murroughs, director, Laboratory of Binocular Seeing, N. I. C. O.

INDIANA OPTOMETRIC ASSOCIATION DISCUSSES FUTURE OF NEW INDIANA UNIVERSITY OPTOMETRY PROGRAM

The new School of Optometry at Indiana University was the chief topic of discussion at the recent convention of the Indiana Optometric Association held at French Lick, Indiana, May 24-26. At the opening business session the Indiana University Optometry School trust fund was established for the purpose of accepting gifts and bequests. At the Sunday evening banquet, George G. Purdy, vice president of Continental Optical Company, Indianapolis, presented a check of

$5,000.00 for the new trust fund. Other past contributions were given recognition, including private gifts and company contributions. The library for the school, and a possible museum, were also discussed, and committees set up to receive contributions of books and museum pieces.

At the educational program of the convention, Dr. R. W. Tubesing of Richmond spoke on aniseikonia and demonstrated the new office (American Optical Company) space-eikonometer.

LIFE FEATURES PICTURES ON PATHOLOGICAL FUNDII

In its June 9, 1952, issue, *Life* magazine featured two pages of pictures, one in color, of diseased fundii as seen through the ophthalmoscope. Included in the color spread were pictures of first, a normal retina, then pictures of fundii revealing glioma, toxoplasmosis, syphilis, hypertension, diabetes, thrombosis, and arteriosclerosis. Photographs were taken through the Zeiss fundus camera. If you didn't catch this issue of *Life* we recommend looking up a copy for interesting reading.

NEW 1952 BLUE BOOK

The new Blue Book is out, and as usual, Marty Topaz and his staff have done a beautiful job with it. The profession is certainly indebted to the Professional Press people for the efforts they put into this directory of optometrists every other year. It looks like a lot of hard work to me. We have looked over the new edition, and we cannot help wondering just what goes on in the mind of an optometrist when he submits copy to the publisher which shows him to be a member of the Academy when he is not. A careless flipping of the pages shows several examples of this. Perhaps this is a compliment to the Academy. Perhaps, also, we had better send Marty Topaz an up-to-date list of Academy members when they are ready to put the 1954 edition of the Blue Book to bed. Despite the criticism it is a fine job, and if you haven't got your copy, you should order one at once.

BLINDNESS PREVENTION

For many years the National Society for the Prevention of Blindness has been working to eliminate all possible causes of blindness. Since Dr. Franklin M. Foote became director of the agency, its activities have increased, and its work has been even more effective than before. Now a new rival organization has entered this field. It is the National Council to Combat Blindness. This new group also headquarters in New York City (1186 Broadway). Dr. Daniel A. Poling is Honorary Chairman. Mr. Silas Adelsheim is Chairman of the Board, and Miss Mildred Weisenfeld is Executive Director. While there is much work

to be done, we wonder if there is need for two competitive organizations in this field.

STUDENT DEFERMENT

In a current Selective Service bulletin, we find the following comment: Selective Service local boards have started to tackle—or will soon tackle—the job of reopening and reconsidering the cases of some 300,000 students to determine their eligibility for further deferment as students.

Newspapers, college publications, and other periodicals in most sections of the country have been generous in devoting space to informational matter concerning student deferment rules and procedures.

Among the points stressed is that students desiring deferments for the next academic year should make written request to their local boards as soon as school is out, and also that they should request their school to issue Form 109 in their behalf, as it is the obligation of the school—not Selective Service—to keep the board informed as to the students' class standing.

The question of whether they would be given 30 days after the completion of their academic year to enlist in the service of their choice has been foremost in the students' mind. The answer, of course, is that a 30-day postponement is unnecessary this year because local boards must reopen each student case, reconsider it, and allow time for an appeal before issuing induction orders. National Headquarters said that these routine procedures would afford students ample opportunity to enlist in the service of their choice. Also, there is nothing to prevent a student from enlisting in the service of his choice up until he receives notice to report for induction, as the interservice agreement is under suspension until June 30 of this year.

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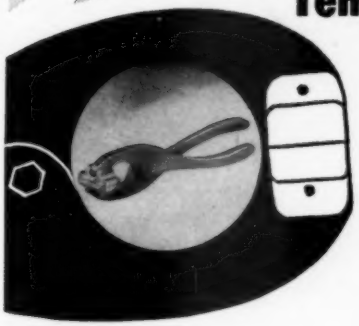

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No. 6 of a Series

like June and Weddings

Any wedding day is a happy day—but it seems to partake of special significance when it's paired with a *June* date. The same is true of Shuron

Widesite **lenses and** ***Browline*** **frames.**

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